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DR. REZSŐ VÁMOS
1913--1977

He was born in Barcs (County Somogy), from a teacher family. Having completed his middle-school studies, he continued studying in the branch natural history-chemistry of the Teachers' Training College. After taking his diploma, he functioned as a teacher in a higher elementary school, for a short time.

From 1939, he did his active military service, then he worked as a teacher of chemistry in the Cadet School. From 1944, he was in service in the field. Returning from the prisonership of war, he was discharged from the army in 1946. After being discharged, he first worked as a researcher in the soil-microbiological laboratory of the Botanical Institute of the Forestry Engineering College in Sopron.

In 1952, he came to the University in Szeged where he continued his research and educational work first in the Botanical Institute, later in the Institute of Plant Physiology.

His scientific research-work initially included the performance of the quantitative determination of soil bacteria with a new method. Later he changed to investigating into the microbiological processes of the intermittently inundated soils. In the course of this, he mainly dealt with the development of anaerobic conditions, the problem of manganese, iron, nitrate, sulphate and phosphate reduction. From among the reductive processes, he mainly studied sulphate reduction, the biological soda-formation, later the circulation of sulphur in the formation of the alkali soil profiles. Because as a result of sulphate reduction hydrogen sulphide is formed, he studied for a long time the physiological effects of hydrogen sulphide, thus the destruction of rice-roots, the fish destructions caused by hydrogen sulphide and ammonia. He investigated into the microbiological conditions, theoretical and practical problems of the Tisza Dead Arms for years.

His publications issued on this subject in home and foreign scientific reviews made his name known. In this country, he was the official expert of the Ministry for Agriculture and Food Supply. The producing institutions frequently took his professional advice, as well.

He was the member of several home and foreign scientific societies. As a member of the Tisza Research Working Committee since the formation of this society, he took an active part until his death in investigating into the Tisza Dead Arms. He often appeared among the rapporteurs of the Tisza Research Conferences. With his exemplary and devoted work he exerted a stimulating effect on the activity of his junior colleagues.

As an instructor, he participated for twenty years in the instruction of the biological undergraduates. He was a member of the Microbiological Department, organized in 1972, and did not cease, even after his retiring, to be active with his youthful ardour in the domain of research and education.

By his death, the Attila József University in Szeged lost a prominent research worker and educator. He still lives in the mind of his colleagues and former students.

His major scientific monographs are:

György eljárások a talaj baktérium flórjájának mennyiségi meghatározásához (Rapid procedures for the quantitative determination of the bacterial flora of the soil). — Agrártud. Egyetem Erdőmérnöki Karának Évkönyve *1.* 131. Sopron. 1950.

A mikróbaföldrajz kutatásainak legújabb eredményei (Recent results of the researches in the microbial geography). — Agrokémia *7—12.* 1950.

A szulfátredukció szerepe és kimutatása a talajban (Part and demonstration of the sulphate reduction in soil). — Magyar Kémiai Folyóirat 1954.

Microbiological processes in limefree alkali soils. — Acta Biol. Szeged, *1.* 1955.

A szulfátredukáló baktériumok szerepe a rizs barnulásos megbetegedésében (Part of the suphate reducing bacteria in the browning disease of rice). — MTA Agrártud. Oszt. Közl. *8,* 3—7. 1955. (With a co-author).

The role of the soil s excess nitrogen in the „bruzone" of the rice. — Acta Biol. Szeged. *2,* 103—110. 1956.

Chemical examinations of flooded water of the rice. — Nature *157.* 180. 1484. 1957.

Nutritive conditions of rice at the appearance of the blas. — Acta Biol. Szeged. *3,* 239—245. 1957.

Talajbiológiai folyamatok szerepe a rizs „bruzone" betegségében (The part of soil-biological processes in the disease „bruzone"). — MΓA Agrártud. Oszt. Közl. *1—3,* 242—250. 1958.

Inhibition of sulphate reduction in waterlogged soils. — Acta Biol. Szeged. *4,* 1973—178. 1958.

Inhibition of sulphate reduction in paddy soil. — Nature *182,* 1688. 1958.

H_2S the cause of bruzone (aki-ochi) disease of rice. — Soil and Plant Food *1,* 37—40. Tokyo 1958.

Bruzone disease of rice in Hungary. — Plant and Soil *11,* 65—77. 1959.

The brown coloration in the tissues of rice plant caused by hydrogen sulphide. — Acta Agronom. *9,* 117—128. 1959.

Antibacterial substances of coniferous seedlings at stages of their development. — Nature *184,* 4690. 1959. (With a co-author).

Significance of application of nitrate fertilizers in paddy soil. — Current Science (Bangor) *28,* 406—407. 1959. (With a co-author).

Halpusztulás a Tisza holtágaiban (Fish destruction in the Tisza Dead Arms). — Halászat *7,* 92. 1960.

A study on the Eh conditions of the rhizosphere in rice varieties resistant and susceptible to „bruzeone". — Acta Agron. *11,* 369—382. 1962. (With a co-author).

Wasserblüte und Fischsterben. — Acta Biol. Szeged. *8,* 103—114. 1963. (With a co-author).

A hidrogén okozta tömeges halpusztulás utólagos kimutatása (Subsequent demonstration of the hydrogen-engendered mass-destruction of fishes). — Hidrol. Közl. *10,* 478—480. 1967.

Die bodenbedingten und klimatischen Faktoren der Unfallkrankheit der Fichtenkeimlinge — Arch. Forstwes. *17,* 287—295. 1968.

Vizsgálatok a tiszai holtágak tömeges halpusztulásainak megelőzésére (Investigations for preventing the mass-destruction of fishes in the Tisza Dead Arms). Halászat *3,* 84—85. 1971.

Palacsi halpusztulás (Fish destruction at Palics). — Halászat *4,* 100—101. 1971.

Miért nincsenek a Duna holtágakban tömeges halpusztulások? (Why are there no mass-destructions of fishes in teh Danube Dead Arms?) — Hidrol. Közl. *10,* 450—454. 1971.

Die ökölogischen Faktoren des durch H_2S und HN_0 bedingten Fischsterbens. — Tiscia (Szeged) *7,* 5—12. 1972. (With a co-author).

Dr. Rezső Vámos published 87 scientific monographs in Hungarian and foreign languages until his death.

Farewell

to Dr. Rezső Vámos *by Dr.* Imre Horváth, *professor of the University in Szeged, Head of the Botanical Department, President of the Tisza-Research Working Committee*

In the name of the Tisza-Research Working Committee, I take leave of Dr. Rezső Vámos, lecturer in our university, a research worker of merit in the Tisza-research. Everybody liked his always gay, friendly individuality. He was not only our co-worker but our friend, as well.

The province of his research work was the microbiological investigation into the water-covered soils. His studies first dealt with the genetics of alkali soils, then with the diseases of rice connected with the soil, as well. But he achieved most of his results in researching rivers, and first of all the Tisza. He joined the Tisza research at the beginning of that and continued performing it actively for twenty years, until the last day of his life. His theory, and practice, elaborated on the basis of clearing up the course of fish and bird death consequent upon the hydrogen-sulphide pollution in the dead arms of rivers and mainly of the Tisza, and of analysing the causes of that, for preventing the desctruction, are of great importance in a practical field, as well.

The results of his investigations have been applied in the artificial fish-breeding, too. He was an outside worker of the fishery at Fehér-tó and dealt with good results with the problems of pisciculture in the lake Fehér-tó.

Apart from the scientific research work, he actively participated in the university education, as well. He taught agrobiology for about two decades and made generations of students popular with that, as a lecturer in the Plant Physiological and later of the Microbiological Departments.

He had a lucid mind of good combinative talent. His interest included a wide field. But primarily the practical problems of the modern way of life stood near him. In addition to biology, he was also interested in the problems of geography and agricultural sciences. He dealt readily, one could almost say as a hobby, with history, as well, first of all with the part of Szeged in the war of independence in 1848—1849.

He was a member of not one scientific society at home and abroad. He has bequeathed to us a rich scientific heritage which has aroused the interest of professional circles not only at home but also abroad, both in theoretical and practical relations.

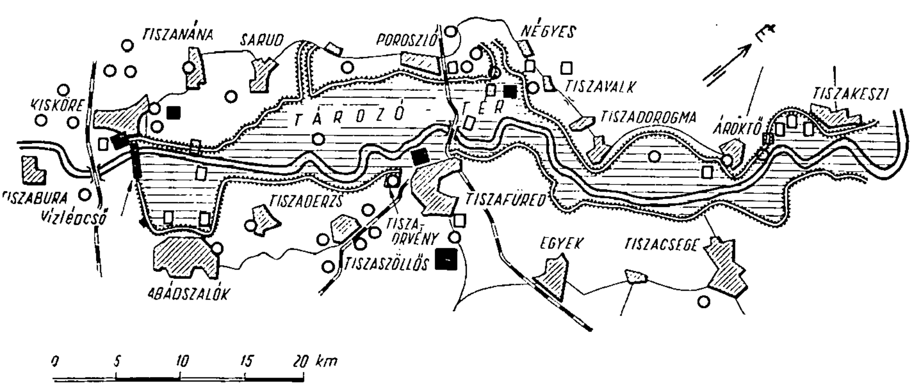
The words of the last farewell are staggering even for a biologist. In vain we know that birth and death are equally natural and unavoidable biological laws. Man perishes by death individually but in his products he survives. In this way you will survive with your products among us! And we shall preserve as sacred the remembrance of your dear, friendly individuality!

Tiscia (Szeged) Vol. XIII, pp. 7—25 (1978)

THE HISTORY OF WATER MANAGEMENT IN THE CENTRAL TISZA REGION

The round 7.200 sq. km area known as the CENTRAL TISZA REGION is formed by plains crossed by a 1800 km long central section of the River Tisza between Tiszafüred and the mouth of the River Körös. Precisely delimited both geografically (hydrographically) and economically, as well as historically, it is a typical lowland, where life and development have at all times been determined by waters.

County Szolnok occupies three-quarters (5,571 sq.km) of its area, the rest including smaller parts of the ad jacent counties, such as the historical regions of Cumania and Jazygia (Fig. 1).



○ findspot ■ full uncovering □ partial uncovering

Fig. 1. Archaeological findspots of the basin of Heves (Kisköre Reservoir and environs) with the Árpádian-Age settlement at Tiszaörvény (fishing-village and harbour.) The floodfree high places of the basin have been inhabited areas since the migration period (Age of Völkerwanderung). On the basis of the map of János Damjanich Museum, Szolnok).

The three principal periods of water management in the region, namely (I) "THE ANCIENT WATER USES OF THE FEUDAL AGE", (II) "THE AGE OF THE SYSTEMATIC REGULATION OF WATERWAYS" and finally, (III) "THE AGE OF SOCIALIST WATER MANAGEMENT", must be considered as a single unit, to throw light upon the regularities and the entire dialectics of development. They reveal the socio-economic determination of development and the mutual relationships involved: the changing and growing role of water and water management in economy and society and, moreover, their impacts on the natural conditions forming the basis of production. (Likewise, they reflect the relatively independent "inner dialectics" of the history of water management. This is primarily determined by "technology", that is to say, the development of the means of production and the experiences in water engieneering and agricultural production.)

Ancient flood plain farming and the beginnings of water engineering works (before 1846)

Beyond being an issue of great importance concerning water management, the knowledge and the more detailed exploration of the ancient, autochtonous "flood plain farming", practiced not only in the Central Tisza Region but certainly in the whole Tisza Valley, are of interest with regard to the general history of economics as well. The importance, which flood plain farming had played in the past has only been recognized in recent times and raised new points of view, possibilities and even tasks in studying economic- and local history, ecology and ethnography.

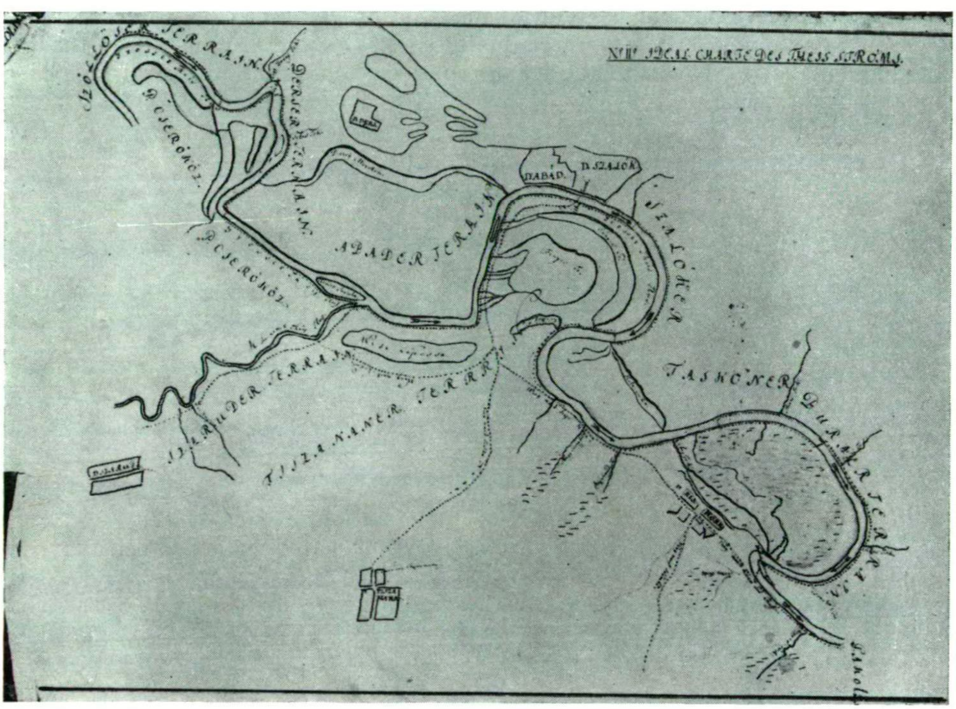


Fig. 2. Central part of the natural flood reservoir of the Heves basin between Füred and Poroszló: the area of Csapóköz and Magyarádpuszta, covered with a network of mortlakes and stews in the 18th century. (Map of JÁNOS LITZNER and JÓZSEF SÁNDOR on the conditions befor the river control, 1776. Eger, Á. L. County Heves. Lt. T. 117 (Photograph).

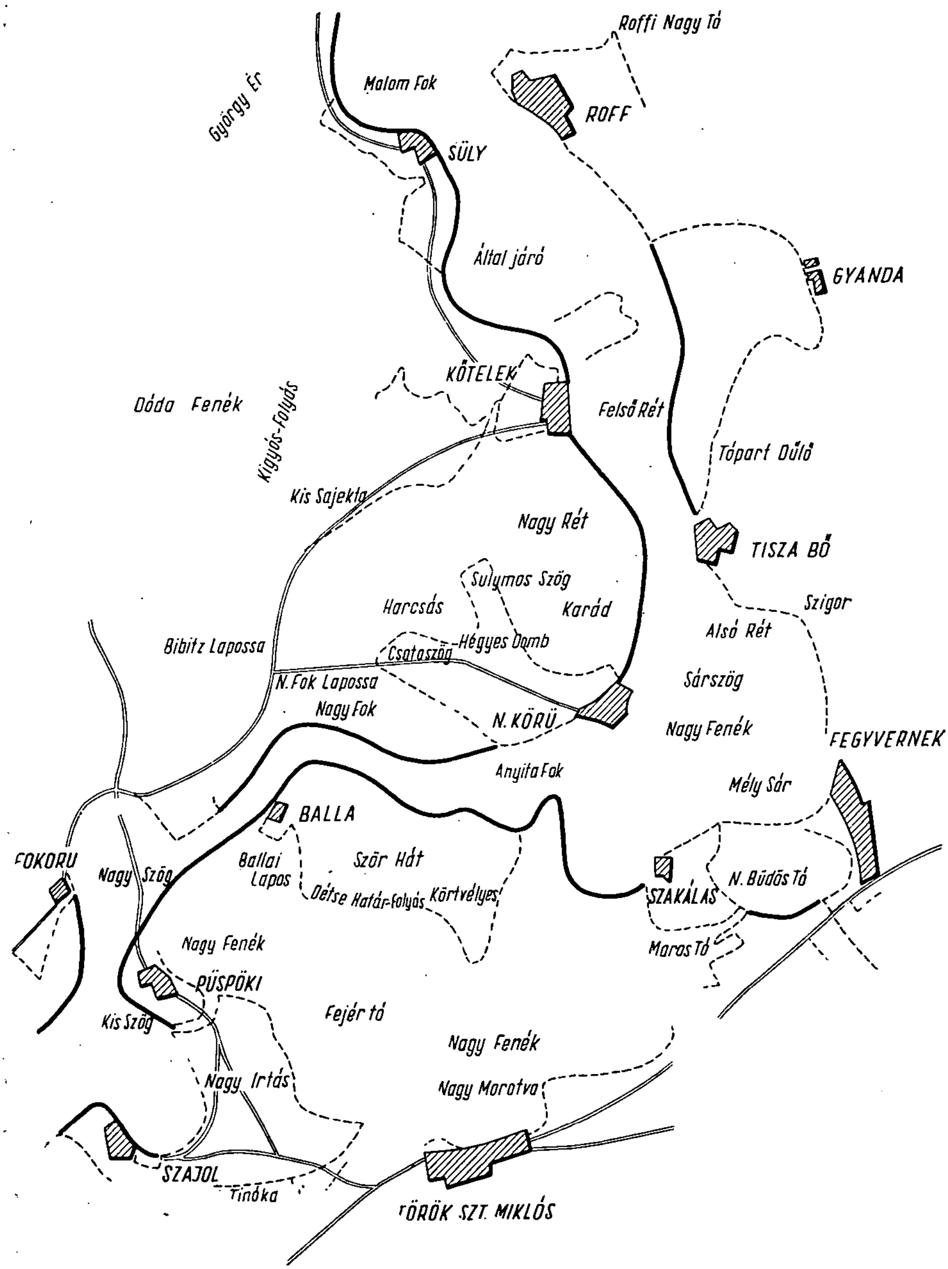


Fig. 2a. Lower part of the natural flood reservoir of the Heves basin between Kisköre and Cserőköz. Hydrography of the area covered with the network of headlands, rills and stews. (Map of János Litzner and József Sándor on the conditions before the river control, 1776. Eger, Á. L. County Heves. Lt. T 117)

In fact, such studies have shown the rainless Hungarian Plains and especially, the driest Central Tisza Region to have always depended on the runoff from the adjoining areas abundant in precipitation and rivers. Of course, the general pattern has been familiar for long,. but the soecific impacts of the floods carried by the rivers and other watercourses on the economy and development of the area was revealed in recent times only. This implies the disclosure of the possibilities, the means and the methods of flood utilization, in other words, the way flood plain farming was performed.

As a matter of fact, the entire economy of the area was based on the life-spending floods of River Tisza and the Körös system: they provided the natural storage irrigation in Spring for the rich and manifoldly utilized lands surrounding the settlements both on the edge of the high banks and on the islands in the flood plain. Before field growing of cereals (i. e. bumper crops) became wide-spread, floods have caused damages in extraordinary cases only. The high waters were distributed, "spread" by the overflow points of the river, brooklets and intermittent streams and the flood water found natural storage in a great number of abandoned oxbow bends, lakes and other depressions covering densely the area. This, on the one hand, has moderated the intensity (and the height) of the flood waves and, on the other hand, has stored the water for plants and animals in the dry season. Up to the second half of the 18th century, this region of the country was the most abundant in lakes, pools and brooklets connecting them, where fishing and fish pond culture flourished since the 11th century (the age of the Árpádhouse). The famous nomadic cattle breeding in the region, first of all in the plains on the left-hand side (Great Cumania and the adjoining Hortobágy) was based on the irrigation of pastures and meadows by the annual floods, as demonstrated long ago by the ethnographic studies of István Győrffy. It is also due to the conditions described that willow, poplar, further reed and rush, etc. have become the principal raw materials for popular architecture and handicraft. In addition, waters also played an important role in other regards in the economy of the region: in ancient marsh fishing and poultry breeding in the settlements around the flood plains, just as in ancient hemp and flax farming, as well as in the famous tobacco farming of Heves which spread in the 18th century, or in the vineyards and orchards known already in the Middle Ages. (Namely, these were planted on the slopes around the flood plains, displacing the ancient gallery-forests in order to make use of the humid micro-climate and of the irrigation possibilities for tobacco farming.)

Even in this region so abounding in waters, ponds and lakes were most numerous — besides the Sárrét in the Körös-Berettyó area — in the Heves basin on the northern, and in the Alpár basin on the southern margin of the region, where a series of fish ponds sorrounded by meadows, pastures and gallery-forests, used since the age of the Árpáds abutted on one another.

In present water management planning efforts are made essentially to make use of these natural conditions — once utilized by autochtonous agriculture but later forgotten for a time offering unmatched possibilities even in our days: through the storage of water by means of the Tisza barrages (Kisköre and Csongrád), as well as by the socalled flood retention reservoirs moderating the flood peaks in the Körös River system. In like manner, the example shown by nature and its ancient utilization is followed by the network of the (Cumanian and Jazygian) main irrigation canals and the adjacent irrigation schemes on the right- and left-hand banks. (Of course, this is performed at a higher level in accordance with the possibilities and the technological standards of our days, and moreover, by multiplying the old possibilities of economic utilization and by bringing the old means and methods to perfection (Fig. 3).

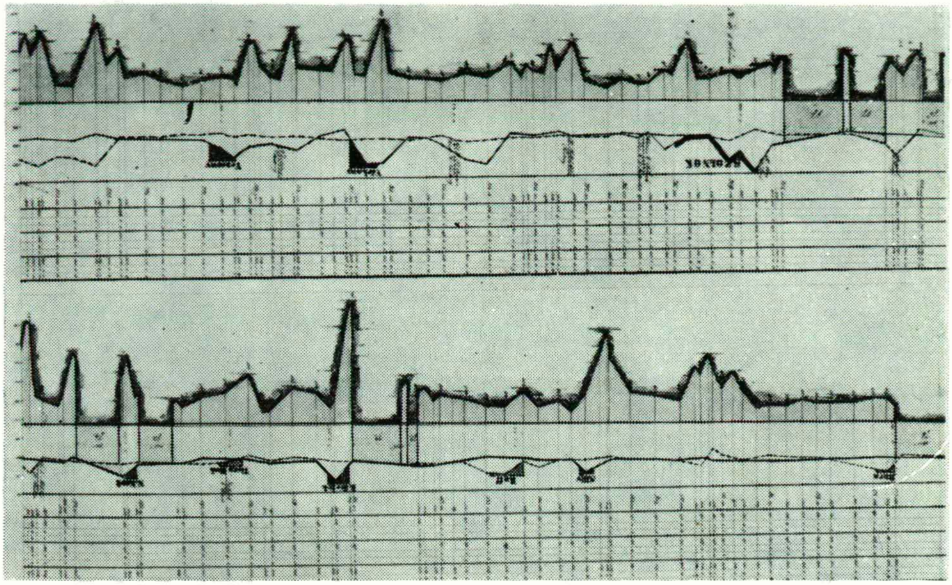


Fig. 3. The development of settlements was not impeded but promoted by waters: a large part of the settlements in the Middle Tisza Region are riverside settlements — coming into being at the edge of the Tisza flood-plain (From Pál Vásárhelyi's Tisza-control longitudinal section. OL. Vizr. Int. Tisza 38).

The age of systematical regulation (1846—1944)

During the 100 years indicated in this title, water regulation has played a decisive role in laying the foundations of economic development and in opening the way for capitalist-type commodity production. Obviously, owing to the conditions of the region described earlier, the solution of the various regulation and reclamation tasks called for a considerably larger amount of work than elsewhere.

This is illustrated by the fact that the numerous cuts carried out in the whole Tisza Valley in order to accelerate the passage of floods have shortened the course of the river by 37 per cent on the average whereas, in the area considered, by 42,7 per cent.

The flood control and land drainageactivities of the watter associations organized by local interests have extended to more than 50 per cent of the area: 360 000 hectares of flood plains were reclaimed and made arable the construction of by 612 km of flood levees. An expecially immense and rather lengthy work has carried out to correct as far as possible the trace of the levees following the meandering river and to develop a relatively regular flood bed. The last major section of the flood plain at Fegyvernek incorporated into the control system as late as 1925 only. Still, the widest flood bed in the whole Tisza Valley is in the region, in the Heves basin and is utilized presently as the Kisköre Reservoir (Fig. 4).

Likewise, *low-water regulation* serving the interests of navigation was needed primarily in the Central Tisza region.

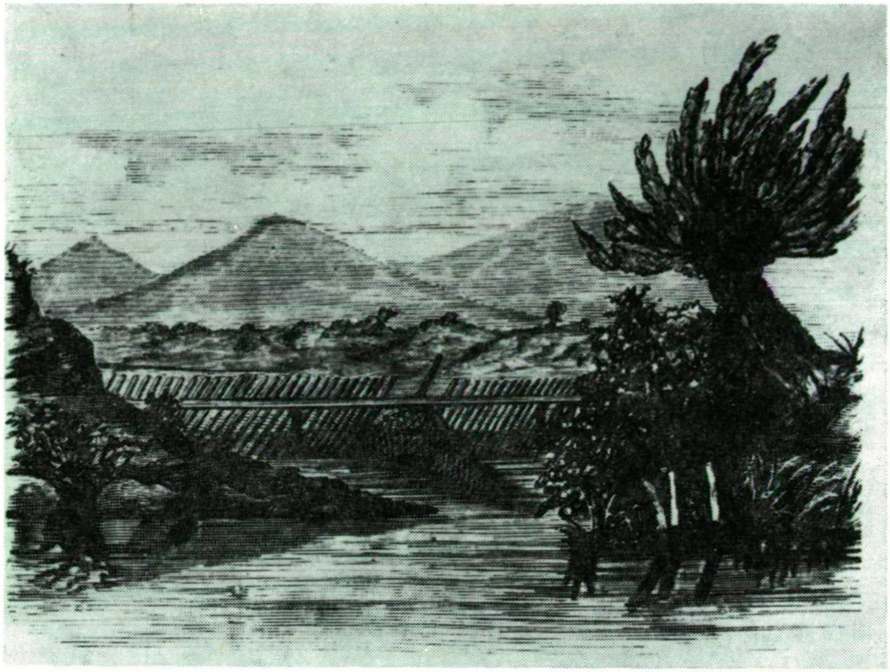


Fig. 4. The so-called headland which had a central part in the ancient flood-plain farming. (After OTTÓ HERMAN)

The extent of *land drainage* which was commenced chiefly in the 1870's also by water associations is characterized by the canal network of 3,133 km lenth and by a large number of pumping stations draining 260,000 hectares. For some associations the area of the flood plain controlled was the same or almost the same as reclaimed by drainage. The first drainage pumping station in the Tisza Valley was built in this region in 1879 (Vol. 2, Fig. 26).

The comprehensive programme of István Széchenyi (1791—1860) the promoter of systematical reclamation, aimed at *watershed regulation in the Tisza Valley* (1846), could however, be realized in part only under capitalist conditions (Vol. 2. Fig. 26). In the interest of commodity production controlled exclusively by market considerations, the water engineering works were confined to flood control serving field growing of cereals (extensive farming with the lowest manpower and capital requirement) and later on, from the 1870's and 80's to land drainage. The neglect of river regulation, which is inseparable from flood control as well as the grave errors committed were not remedied until the turn of the century, on the basis of *the long-range work programme* (1891) of Jenő Kvassay (1850—1919). The elimination of damages caused by waters, which implied only one side and the first steps of Széchenyi's Reform Age concept, was eventually distorted to a one-sided attempt "to get rid of waters at all costs". All this happened in spite of the fact that it was not only the promoters who saw the complexity of the tasks involved but also, as early as at the end of the last century, Kvassay very definitely drew up the future's water storage and water resources management tasks. (To illustrate how much a project may differ

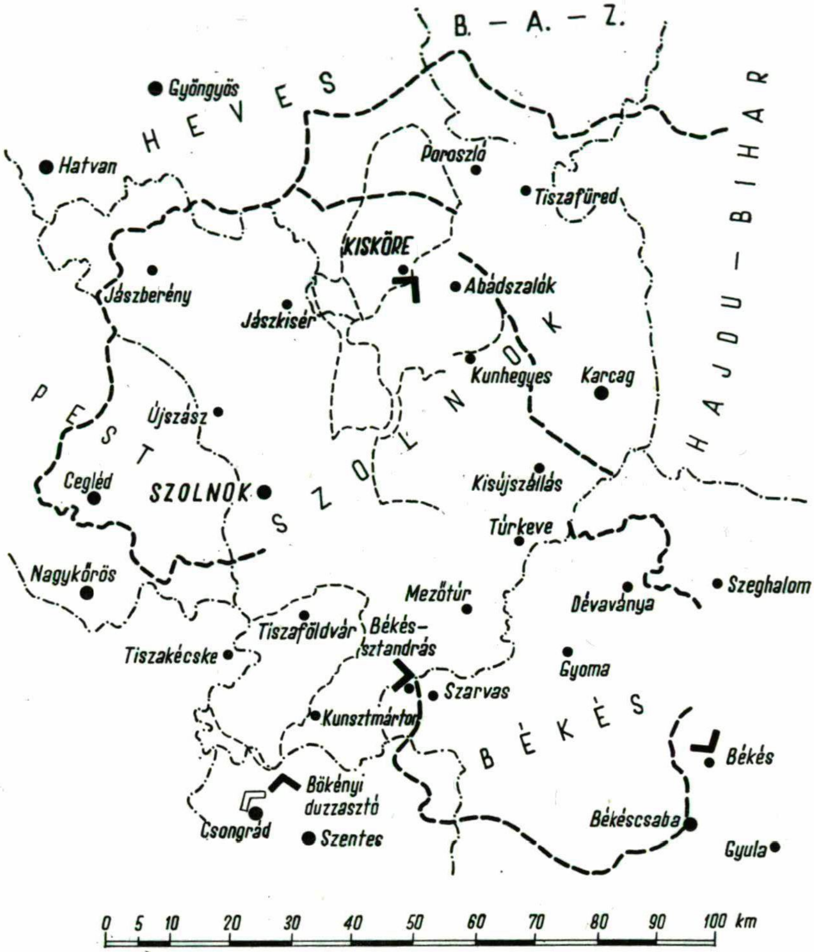


Fig. 5. Flood-plain settlement-conditions of the area below Kisköre, before river-control. Afte Sámuel Lányi's survey of 1833—1845. (Planned by ZSIGMOND KÁROLYI, drawn by ÉVA VICZIÁN

from and, more then that, turn against the intentions and the objectives of its initiators, the history of the Tisza regulations provides a very characteristic example: the works carried out did not only impede but, virtually, put an end to the water uses ot be developped in the first place, such as navigation, irrigation, fishery and pond farming and, for a time, they even removed the possibilities of not only their development but also their practice.

For this distortion of development the mechanism of capitalistic commodity production was responsible. Where production is controlled by the interests of a remote market and development turns against the local conditions and requirements, where profit is the only objective of production and the sole measure of its effectiveness, there, beyond exploiting manpower, this self-determined mechanism with its ruthless exhaustion exploits nature itself in the same way. Together with its other inherent contradictions, it leads inevitably to disturbances in the balance between

Fig. 6. Characteristic village on the Tisza-banks, in the middle of the 19th century. Contemporary cut.

Fig. 7. Characteristic flood-plain reed-bank and willow-poplar grove in the middle of the 19th century. Contemporary cut.

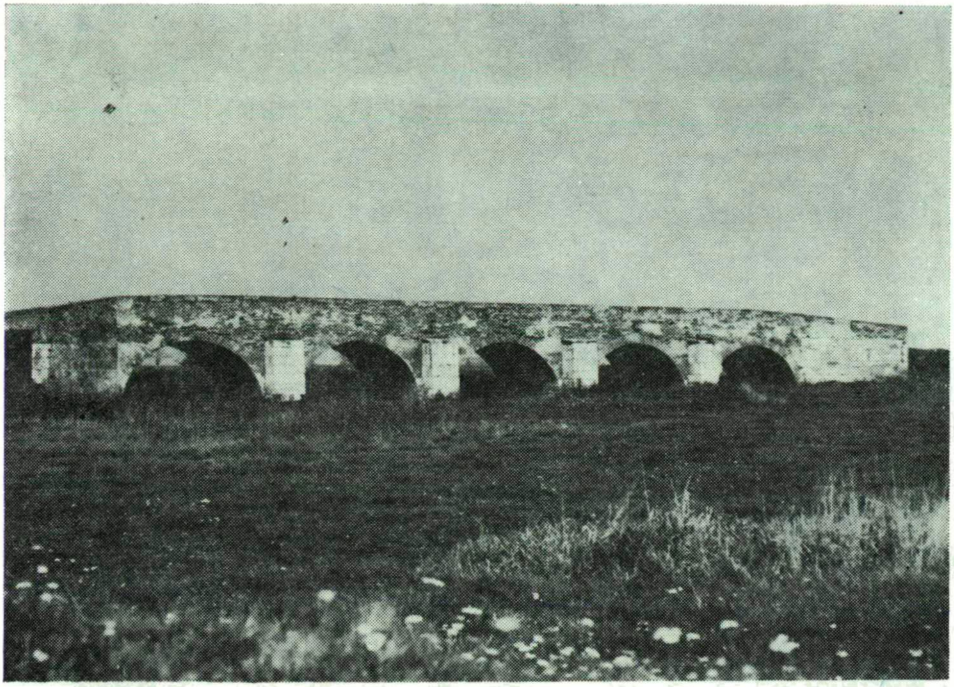


Fig. 8. The Zádor-bridge was at its building (1805—1809) the longest bridge of the country; it bridged over a bigger water-course than the Hortobágy. Its two outermost arches were washed away by the extraordinary flood in the Tisza-valley in 1830. Since then — after the formation of the system of dry farming ("agger")—it stands dry in the middle of the steppe ("puszta"), east of Karcag, at the edge of the Hortobágy National Park. The former bed of the Zádor has fully filled up and disappeared without any trace.

the natural environment and society, as it has become widely known from recent ecological studies.

As a particular, local reflection, of this general law no advanced water utilization in accordance with the ancient water uses based on natural conditions and centuries of experience, such as navigation, fishery and pond farming, irrigation and animal breeding on irrigated pastures etc., could develop. Moreover, together with the dissolution of the ancient forms, in fact, as a result of flood protection itself, all activities of this short gradually came to an end.

This was why the *irrigation programme* (1937) initiated in 1931 by Elemér Sajó (1875—1934) (Vol. 2, Fig. 36) who in his attempt to find a way out from the impasse, returned to the Reform Age traditions, could not get — even up to the present — beyond the introductory-preparatory stage. (The situation and tasks of the water service were aggravated by the advent in 1940 of a wet period with extensive precipitation, floods and excess runoff, causing damages unprecedented in the first half of the century.)

Fig. 9. Characteristic Tisza headlands on the confines of Tiszadob and Tiszalucz — among them the headland at the Hortobágy and Zádor. On August 27, 1846, on the old proposal of MÁTYÁS HUSZÁR, the work of Tisza-control began here. (Detail from Pál Vásárhelyi's Tisza-control longitudinal section, 1845)

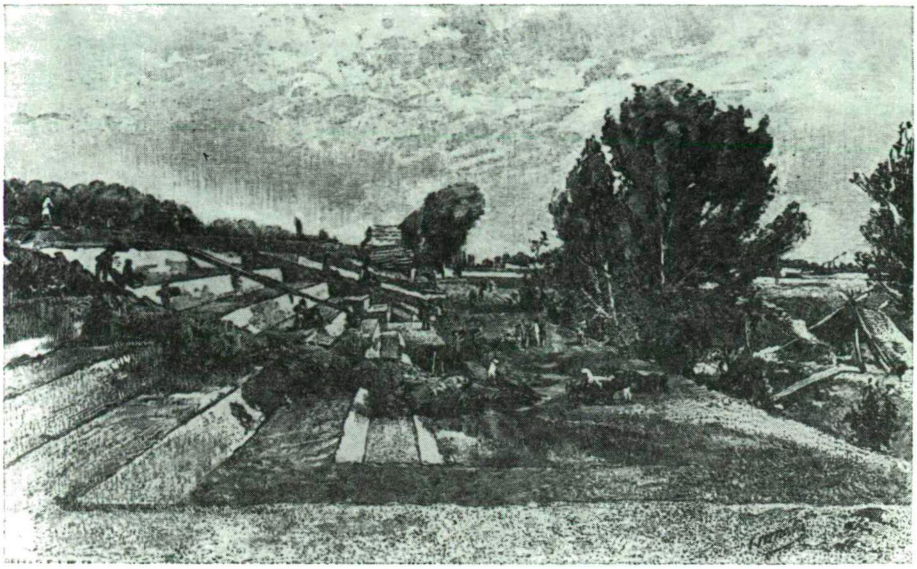


Fig. 10. Works of dam-development at the Tisza in the 1880s. (Contemporary cut) (KTV II, Fig. 22, p. 67)

The impacts of the socialist water management (1945—1975)

It was on these bases, burdened with this heritage and, under conditions aggravated by the destructions of war, that the reorganized water service started its activity in 1945.

The efforts at the rapid reconstruction of the destroyed flood control and drainage works by which the grave dangers of the floods in the years 1945 and 46 were averted are comparable to the memorable success of flood protection in 1919. (To appreciate this achievement it should be taken into account that owing to wartime evacuation, the local water organizations were deprived of the upper technical guidance in the most crucial moment.)

More recently major flood control works were carried out in the Szolnok area, mainly along the river Zagyva and on the right-hand bank of the Tisza River. Besides preventive measures and good organization, this has also contributed to averting from the region the dangers of the great flood on the River Tisza in 1970.

The main *obstacles* to irrigation farming were removed as the distribution of land made an end to feudal property conditions. At the same time the introduction of planned economy has offered new *possibilities* for the realization of old ambitions and projects. The difficulties of reconstruction and the voluntarist tendencies in the economic policy have, however, guided development towards objectives and at a pace, which proved economically and technically unsound and unfounded. Nonetheless, the work inspired by the long-awaited possibility to achieve the old projects yielded significant results, even in spite of the disturbing elements.

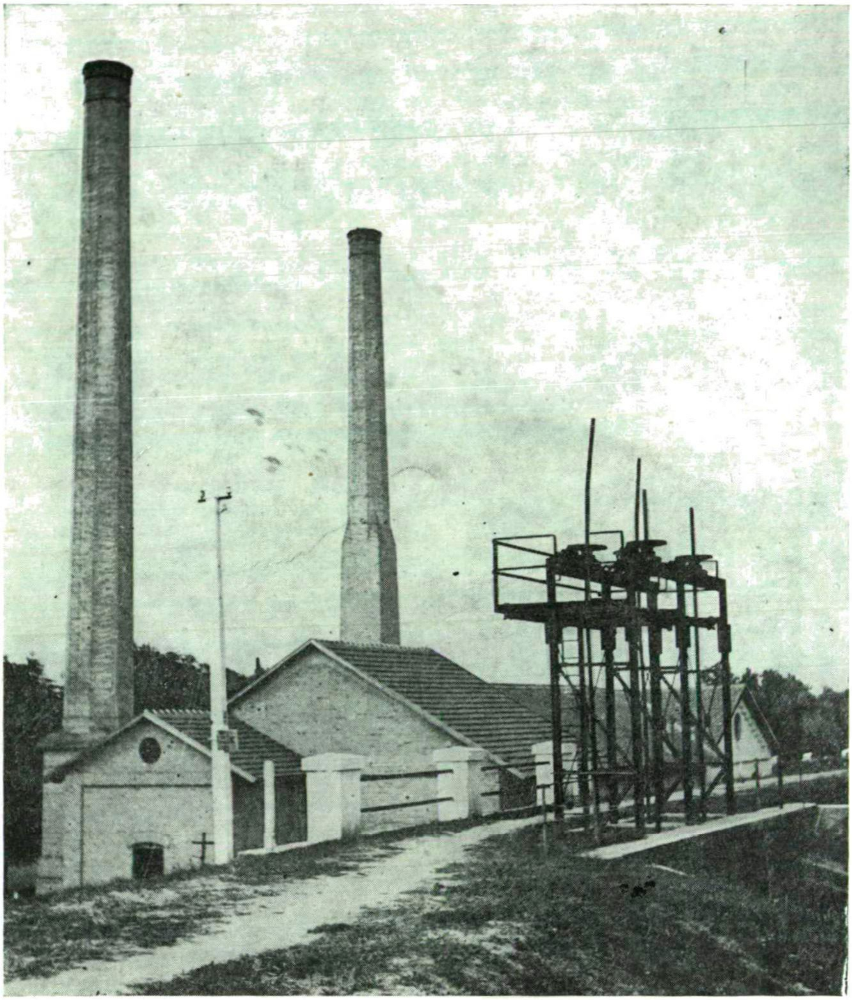


Fig. 11. Pump station at Sajfok, built in 1878. Its first machine unit was still to be brought from England. The later ones were already delivered by Hungarian factories. They are in good working order even today, fulfilling an auxiliary role. (The pump station is "a technical memorial")

The work of the water service was always flexibly adjusted to the requirements and tasks as they arose and provided the appropriate conditions for their solution. of the major technical innovations of the transition period mention must be made of the mobile pumps (Kienitz pumps) that proved indispensable in both land drainage and irrigation; of the introduction of floating diversions (1948); and the use of the Kund-type trenching plough in the construction of irrigation plants. The overloading of the drainage network, which was used also for irrigation (i. e. the delay of the separation of the two systems), and rice growing as monoculture for the utilization of alkali soil areas, has, however, soon slowed down the pace of development.

In spite of the practical errors, the early stage of irrigation development has positively demonstrated that no economic evolution of the region is possible without the most wide-spread use of irrigation farming.

Simultaneously, the need of developing also the traditional form of fish pond farming to utilize the conditions of the area in a highly reasonable manner, for the retention of excess runoff and for the storage of irrigation water has been generally

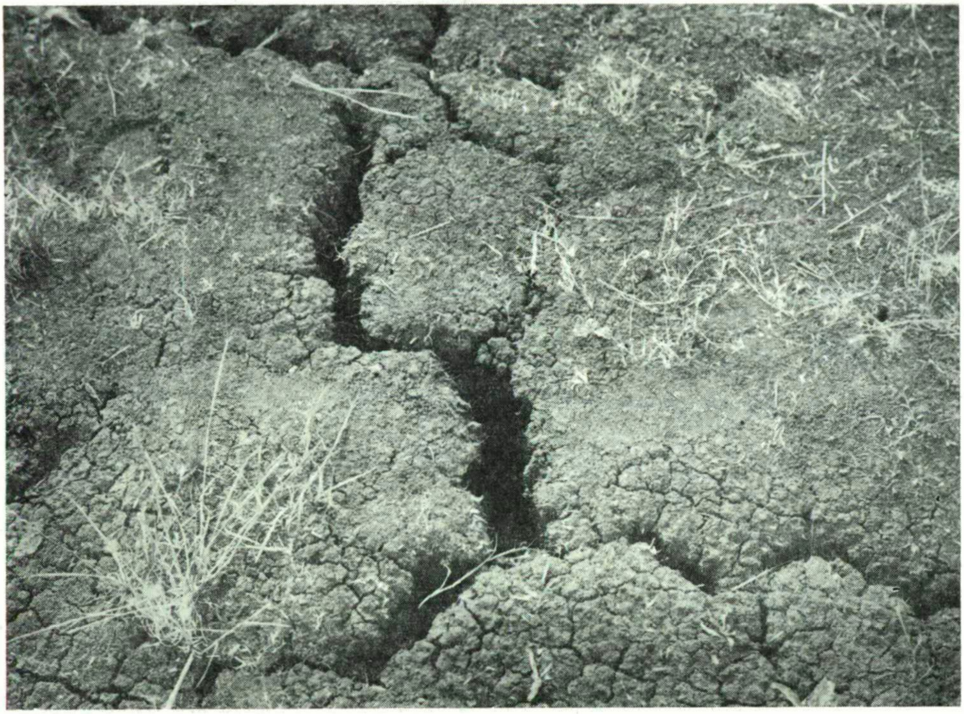


Fig. 12. The "thirsty earth". A characteristically hard ground with rents, in the time of dry farming in a year of drought — in the Nagykunság.

recognized. (Up to 1975, 25 fish ponds have been established with a total area of 1,884 hectares.)

The development of agricultural water utilization, first of all of irrigation, as well as of water resources management in the area has been made possible by the largest and most significant project not only in the canalization of the River Tisza, but also in the entire Hungarian water management, namely the Kisköre barrage and its reservoir

The storage lake above the barrage, with a surface of 127 sq. km, will provide a storage capacity of 300 and 400 million cu. m. by the end of the second- and in the ultimate — stage, respectively; with its rate of flow of 144 and 175 cu-m/sec, respectively, it will supply water for round 300,000 hectares of irrigated land and 12,000 hectares of fish ponds.

The barrage is, however, more than a project of purely agricultural interest, in that it contributes also to both industrial and domestic water supply. The latter

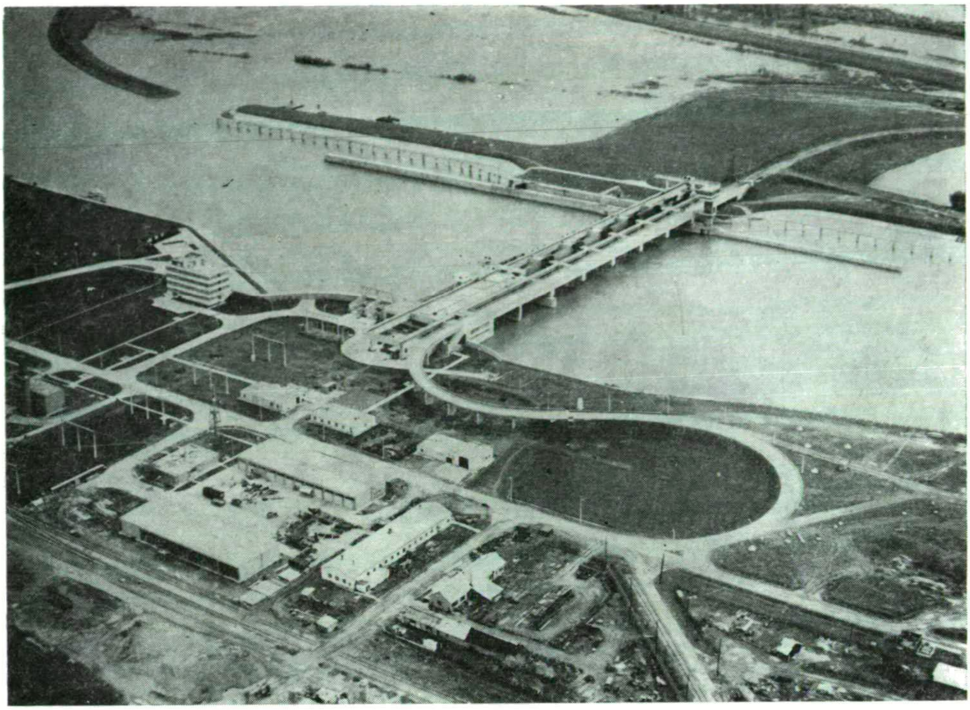


Fig. 13. Our largest hydraulic establishment, the Kisköre River Barrage, prepares the ecosystem change from dry farming towards irrigation. (Its reservoir is under filling)

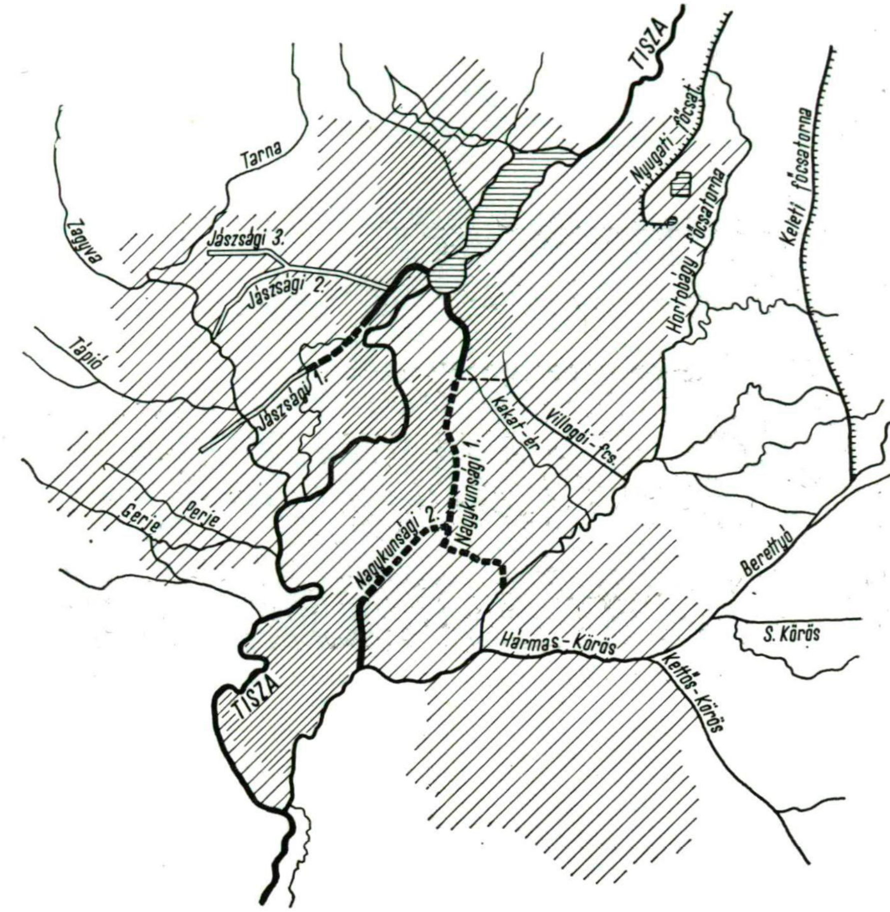
contribution is an indirect one, since by meeting other demands ground waters of potable quality are liberated for domestic purposes. Thus as the most significant storage lake in this country so far, it is the *first large project of new, advanced water resources management based upon storage,* which offers the only workable solution under the conditions of our country. It is of extraordinary theoretical and practical importance as the starting point of regional development in the Central Tisza Region.

(It will meet the water demands in the area up to the completion of the Csongrád Barrage and the Danube—Tisza—Canal.)

As a multi-purpose water management project, the barrage represents a considerable progress also in the development of waterways, through extending the navigable reach of the Tisza River by 120 km. Its hydroelectric plant doubles the country's water-power utilization, and beyond improving project economics, the energy produced is very significant, especially from the local, or the regional view-point (103 million kWh/year).

It is also worth mentioning that the potentialities are open for a completely new recreation area capable of accomodating 50,000 people along the 40 km long shore of the storage lake and in this context, the lake will help of solve the environmental problems of the region.

Besides the development of irrigation, as well as of storage — and water resources management, the most important progress has been made in the field of public utility water supply.



▬ I ------- II ═══ III main work built in the tempo of building in irrigations
//////// having functioned already in 1975.

Fig. 14. The Kisköre River Barrage and its irrigation works. A well arranged plotting of the main works and irrigations (1975).

The expansion of water works, based on an abundant source of supply, has become an especially effective factor in the development and "urbanization" of the town *Szolnok;* it is the indispensable basis for improving domestic water supply and for growing industrialization alike.

The once densely populated and important Jazygian-Cumanian towns (Jászberény, Karcag, Kisújszállás, Túrkeve, etc.), which rivaled even Szolnok in size and economic significance, have gradually slowed down in development, lacking compar able sources of supply. The limits of their water works with drawing water from deep confined aquifers are the limits to their urbanization and industrialization as well. Consequently, it is urgent and of vital importance for improving their adverse position to establish the "Central Tisza Regional Water Supply System", which will be of the same basic importance for the future of the area as the Kisköre barrage and storage lake.

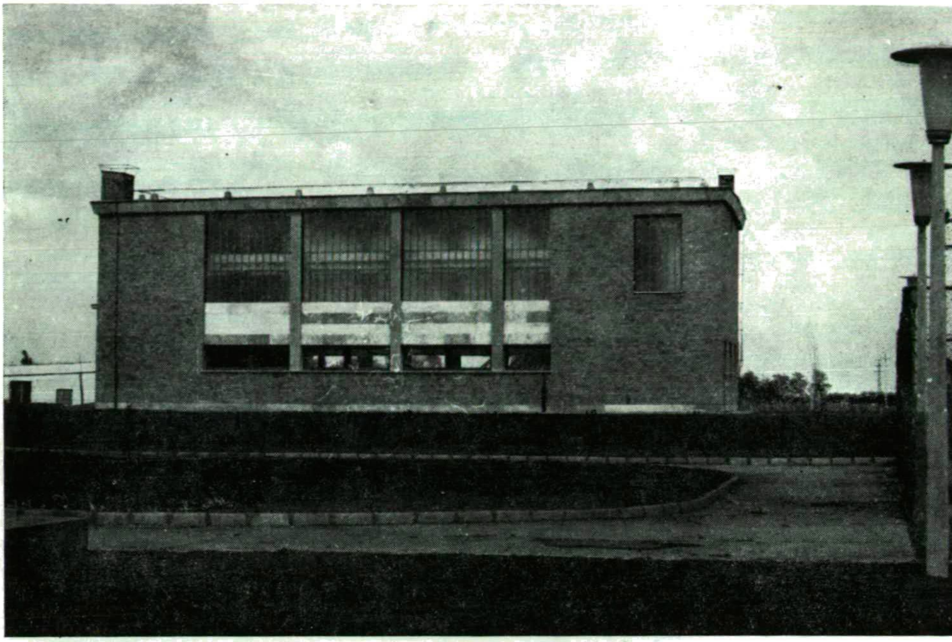


Fig. 15. Automatic centre of pressure of an up-to-date irrigation plant at Kisujszállás.

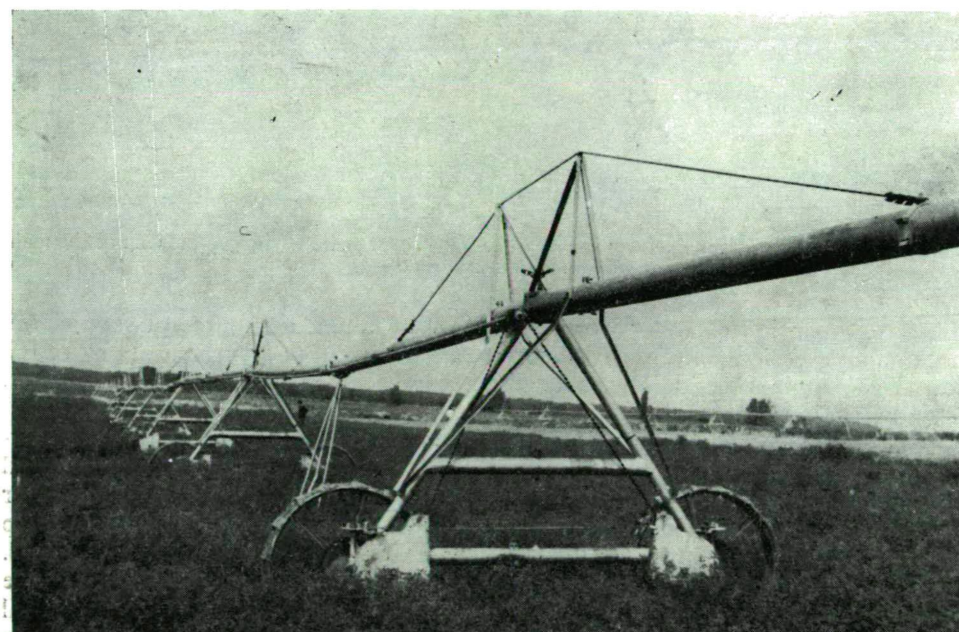


Fig. 16. Up-to-date raining plant of machine transplantation int the Nagykunság.

- - - NK XII border of irrigation plant
/////// sprinkling plant at Mezőkéke
||||||||| sprinkling plant at Tiszaföldvár
\\\\\\ sprinkling plant at Kungyalu
▬▬ irrigation channel
○ pressure centre
⊗ provisional floating drainage

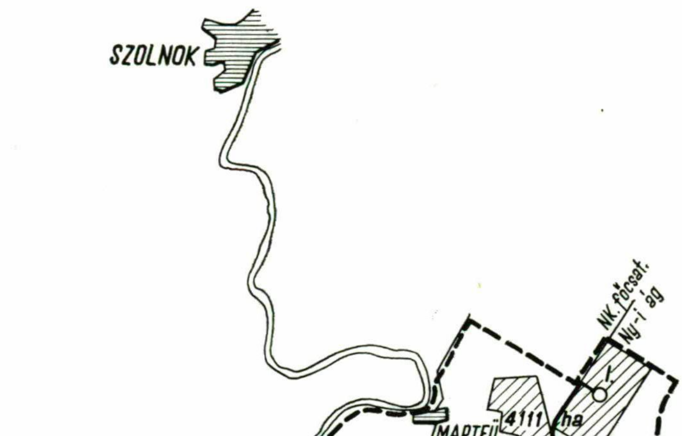
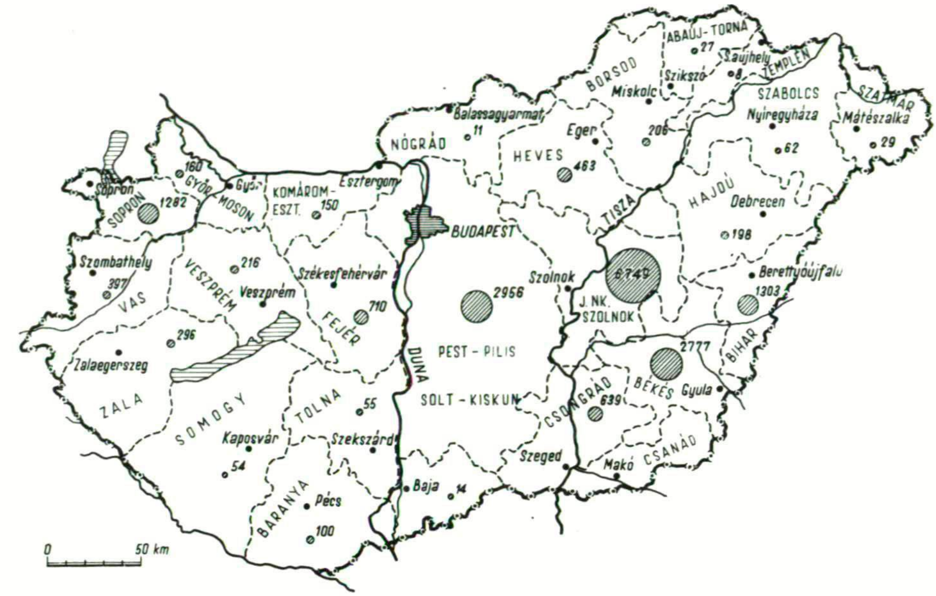


Fig. 18. Provisionary float-governed water-hoisting of Main Channel NK—II at Öcsöd



—·—·— national boundary ——— county frontier

① The surface of circles is proportional to the area inundated (in hectare).

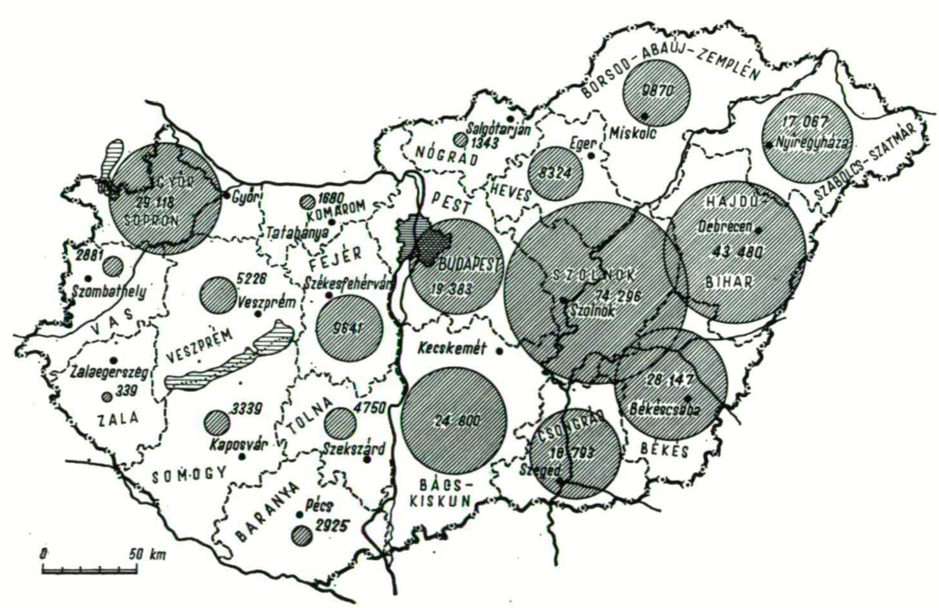


Fig. 19—20. The development of irrigation in Hungary between 1948—1974. (Grouping according to counties)

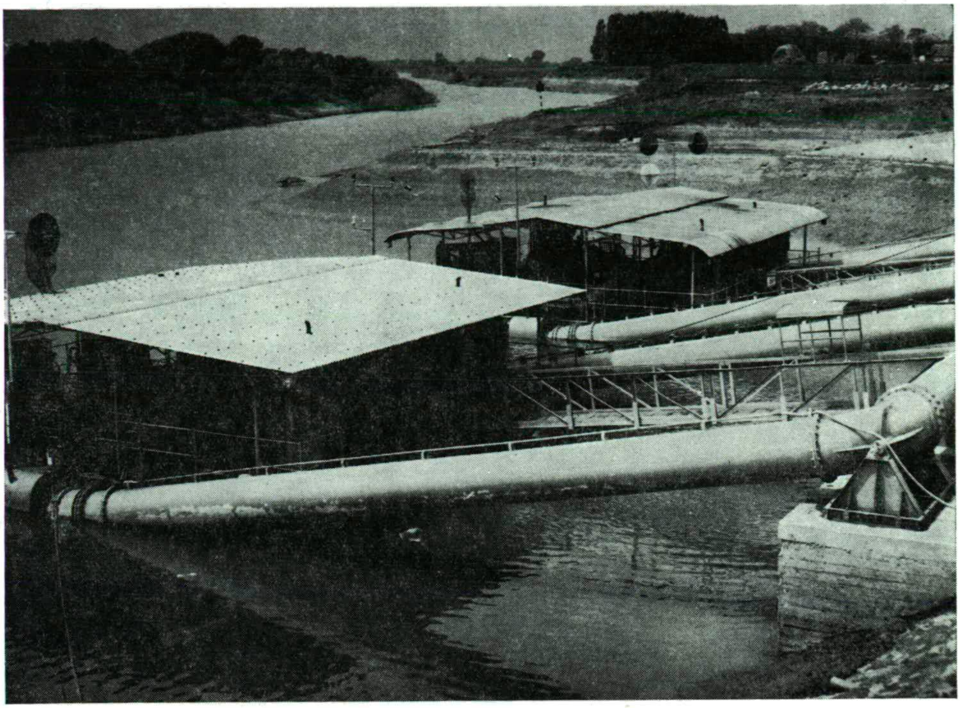


Fig. 17. Irrigation plant NK—XII — in the Nagykunság, built in the most fertile region of the country.

From the analysis of the 30 years of water management development a very essential conclusion can be drawn; namely, the building up of socialism (i. e., socialist industrialization passing through the same course of development as the first industrial revolution but in a planned and accelerated way) has arrived at a new period, which is characterized by the worldwide process of the "second industrial revolution" (i.e., the technical-scientific revolution) and urbanization.

As a consequence of this evolution, the Central Tisza Region considered underdeveloped not long ago is also confronted with all the typical problems of this new period, including besides water management and pollution control, the general problem of environment protection as well.

Zs. Károlyi

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ALGOLOGICAL INVESTIGATIONS IN THE DEAD-TISZA AT LAKITELEK-TŐSERDŐ

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Abstract

In this paper I report on the algal flora of one of the dead arms of the river Tisza, on the basis of investigations performed during the years 1975—1977. The northern part of the dead arm belongs to the National Park of Kiskunság. It was, therefore, examined more intensively than the non-protected southern part. The tabular account on the 286 taxons gives a survey over their appearance in space and, on the basis of an estimate, over their quantitative relations. A nova variation is reported as well, getting its name of the river Tisza. Five algal mass productions with water bloom observed in the protected area lead us to conclude that the eutrophic character intensified.

Introduction

The Dead-Tisza on the S, SE confines of the commune Lakitelek is the orogonal river bed, meandering by and large in V-form W. of the present-day river. It considerably differs from the regional character of the small dead arms at Tiszaalpár, S of it, and at Tiszaug, east of the river Tisza, respectively. The two latter dead arms fall to a plain Holocene area while the medium part of the dead arm at Lakitelek-Tőserdő is connected with the wavy relief of the sand world of the Plain between the Danube and the Tisza rivers. This dead arm preserved the most the former river-bed character, its water is the deepest, only its ends are marshland-like. This geological quality manifests itself in the composition of the flora and the picture of vegetation, as well.

The northern, larger part of the dead arm has been, since 1976, area No. I. of the National Park of Kiskunság. (Fig. 1. The parts under nature conservation are limited with thick dotted lines). The southern part is not protected and will be a part of the large reservoir, planned for the future at Tiszaalpár. The algological investigations performed here are, therefore, justified not only by the points of view of nature conservation but also by the interests of preserving the invironment.

Materials and Methods

In the nineteen-sixties we took a few water samples from here but the samplings in the appointed places only began in 1975. As a first step, we have investigated the western part of the water including the protected section (biotope group "A") and the non-protected southern part (biotope group "B"). The bioseston samples were partly taken by ladling, partly by filtering through a plankton-net. Investigations were made in every season. The taxons were determined as much as possible in living

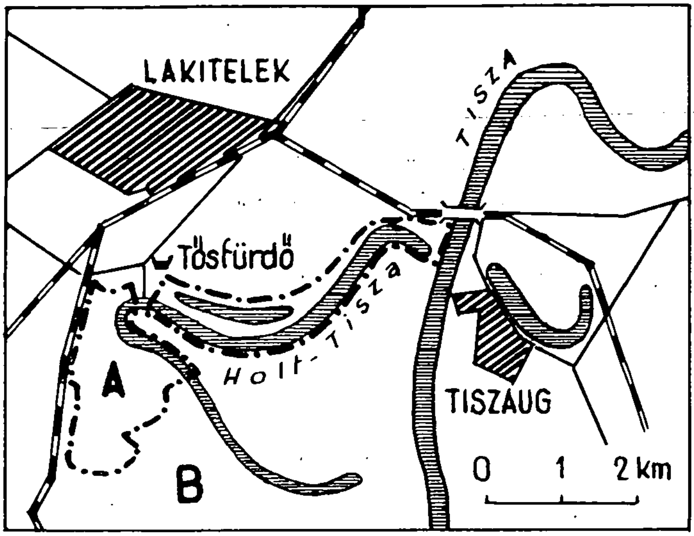


Fig. 1. Dead-Tisza at Lakitelek. The parts limited with the thick dotted line are nature conservation areas.

material. Of the characteristic or rare species microphotographs were made as well (Plates I—III) The material was fixed in formaldehyde. At the sites of the single biotope groups not only the horizontal distribution of the phytoplankton was investigated but, occasionally, some bioseston samples were even taken from the different levels down to 3 m depth.

Results

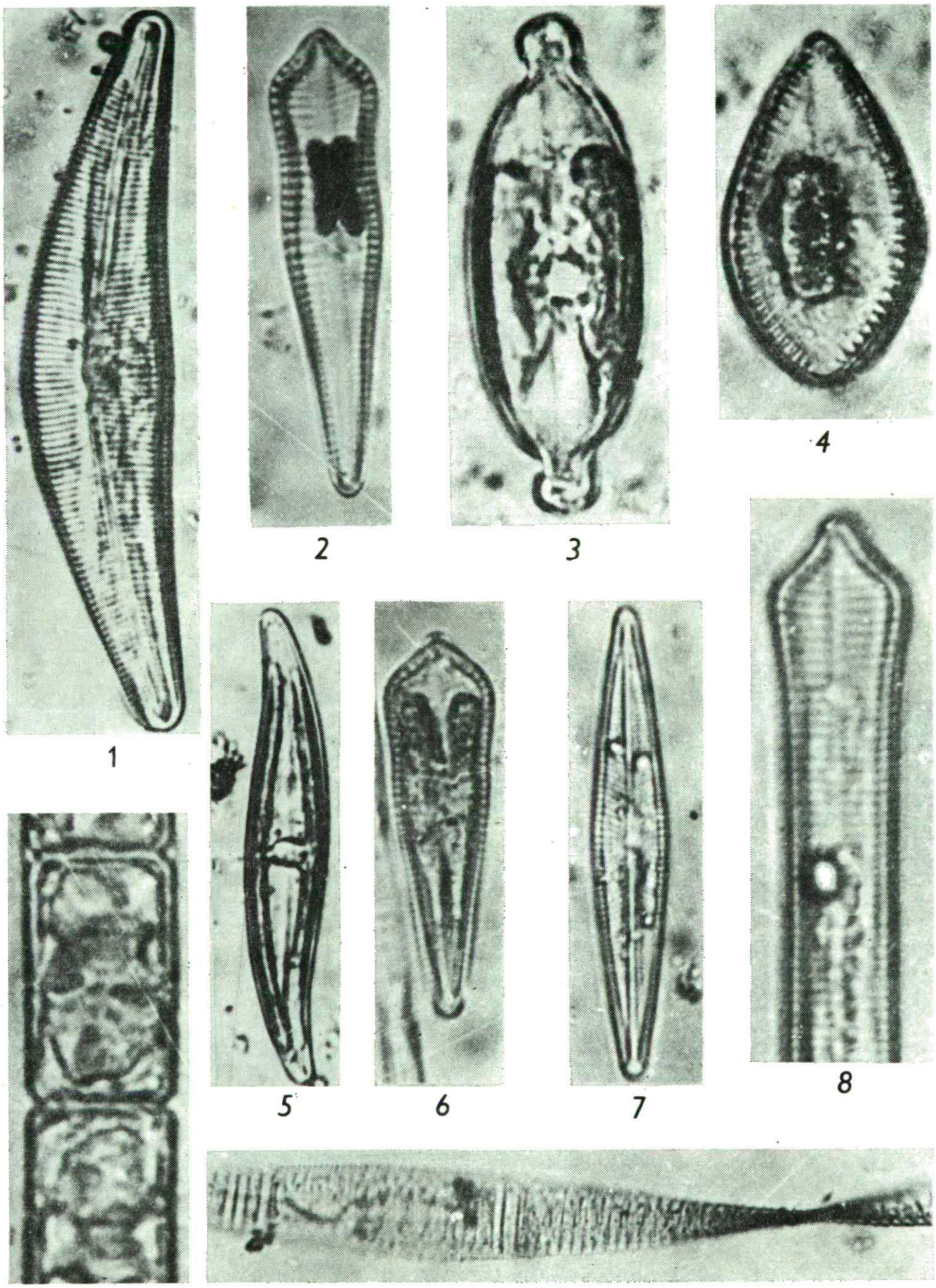
From the Dead-Tisza at Lakitelek-Tőserdő, there have been demonstrated 286 algal taxons so far, divided according the phyla as follows:

Cyanophyta: 43, *Euglenophyta:* 24, *Chrysophyta:* 93, *Pyrrophyta:* 15, *Chlorophyta:* 111. In the respect of the taxon number, the *Chlorophyta* phylum takes a prominent part with the *Chrysophyta* taxons being only smoewhat less. Within the latter, the taxon number of *Diatoma* is particularly high. The enumeration of taxons — in the sequence of phyla — is shown in Table 1. The stretch participating in nature conservation is designated as biotope group "A" and the non-protected part is biotope group "B". The bioseston proofs of biotope group "A" were taken from six sites, the water samples of the biotope group "B" from four sites, taking into consideration

Plate I

1. *Cymbella cymbiformis* (Ag.) Kütz. — 850:1.
2. *Gomphonema acuminata* Ehr. — 850:1.
3. *Caloneis amphisbaena* (Bory) Cleve — 800:1.
4. *Surirella ovalis* Breb. — 600:1-
5. *Gyrosigma acuminatum* (Kütz.) Rabenh. — 300:1.
6. *Gomphonema acuminatum* (Ehr.) var *trigonocephala* (Ehr.) Grun. — 850:1.
7. *Navicula radiosa* Kütz. — 850:1.
8. *Synedra capitata* Ehr. — 1700:1.
9. *Melosira varians* Ag. — 1100:1.
10. *Fragilaria capucina* Dezmaz. — 250:1.

Plate I



the ecological conditions. In the bioseston proofs, the quantitative conditions are generally established by estimation, although, in the respect of a few species, Bürker's chamber countings were also performed. The degrees of quantitative abundance established by estimation, are as follows: 1 = rare or sporadic occurence, 2 = frequent, 3 = very frequent occurence, 4 = presence in mass, resp. the formation of mass production.

By surveying the tabulated enumeration, it can immediately be established that the overwhelming majority of taxons occured in both biotope groups. This shows that there are no considerable differences yet in the essential conditions between the two parts of the Tisza Dead Arm, taking or not taking part in nature conservation (A, B). However two differences in the distribution of taxons should be mentioned. One of these is that in the bioseston tests of the non-protected biotope group "B" the taxons of *Euglenophyta* were much more frequent than in the water of the protected biotope group "A". The explanation of this is mainly that biotope group "B" — particularly its southernmost section — is close to the agriculturally cultivates areas from which pollution with farmyard manure may occur from time to time. The other difference in the distribution of taxons is that some of the species were only found in one of the biotope groups.

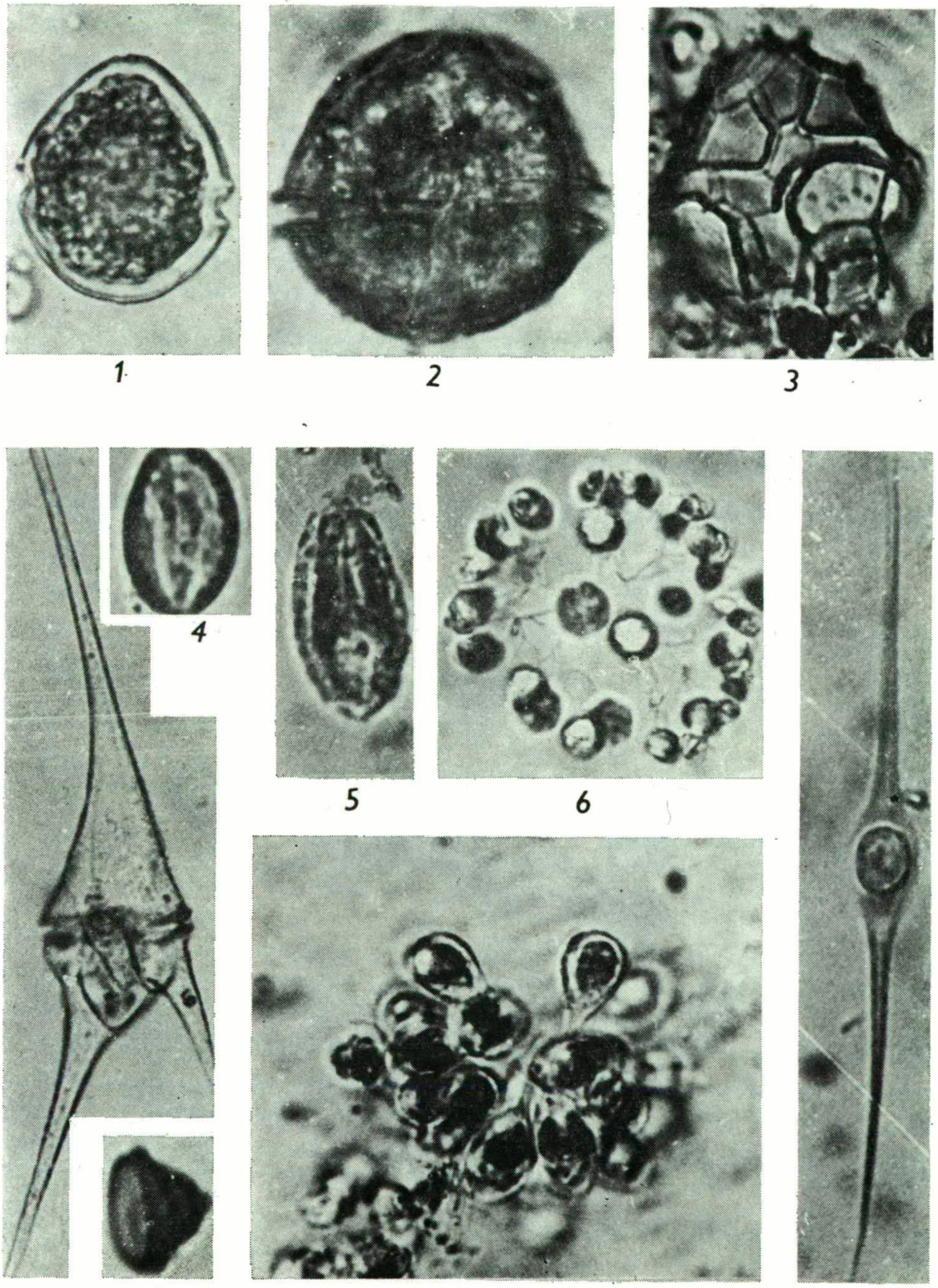
The following taxons appeared exclusively in biotopic group "A": *Microcystis aeruginosa* KÜTZ. f. *aeruginosa* STARMACH, *M. aeruginosa* KÜTZ. f. *flos aqae* (WITTR.) ELENK., *Anabaena affinis* LEMM., *Spirulina corakiana* PLAYF., *Oscillatoria formosa* BORY, *O. lauterbornii* SCHMIDLE, *O. planctonica* WOLOSZ., *O. simplicissima* GOM., *Phormidium tenue* (MENEGH.) GOM., *Lyngbya limnetica* LEMM., *Asterogloea gelatinosa* PASCHER, *Chlorobotrys simplex* PASCHER, *Centritractus africanus* FRITSCH et RICH., *Centritractus belenophorus* LEMM., *Ophiocytium cohleare* A. BRAUN, *Chromulina freiburgensis* DEFL., *Chrysoglena verrucosa* WISL., *Dinobryon tabellariae* (LEMM.) PASCH., *Mallomonas bernardinensis* (CHOD.) CONR., ?*Pseudosyncrypta spec., Tessella volvocina* PLAYF., *Cocconeis pediculus* EHR., *Melosira granulata* (EHR.) RALFS, *Melosira varians* AGARDH, *Pleurosigma elongatum* W. SMTH, *Cystodinium bisetosum* (LINDEM.) HUBER-PEST., *Glenodinium edax* SCHILLING, ?*Gonyaulax apiculata* (PENARD) ENTZ, *Peridinium volzii* LEMM. var. *cinctiforme* LEF., *Desmatractum bipyramidatum* (CHOD.) PASCH., *Scenedesmus acuminatus* var. *elongatus* W. SMITH, *Schroederia setigera* (SCHRÖD.) LEMM., *Schroederia spiralis* (PRINTZ) KORSCH., *Staurastrum omearii* ARCH. —

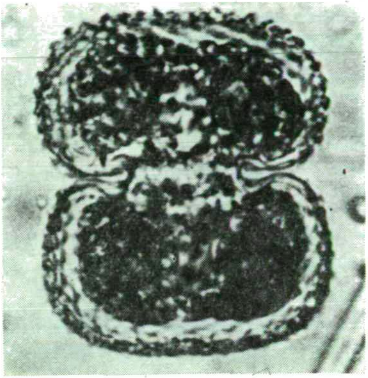
On the other hand, the following species may be mentioned exclusively from biotope group "B": *Tetrapedia reinschiana* ARCHER, *Euglena allorgei* DEFL., *Euglena chlamydophora* MAINX, *E. limnophila* LEMM., *E. velata* KELBS, *Lepocinclis ovum* (EHR.) LEMM., *L. steinii* LEMM., em. CONR., *Phacus myersi* SKVORTZ., *Ph. pyrum* (EHR.) STEIN, *Chlorococcum humicolum* (NAEG.) RABENH., *Nephrochlamys allantoidea*

Plate II

1. *Glenodinium edax* SCHMIDLE — 1000:1.
2. *Peridinium cinctum* (O. F. M.) EHR. — 950:1.
3. *Peridinium palatinum* LAUTERB. — 850:1.
4. *Chromulina freiburgensis* DOFL. — 1800:1.
5. *Chrysoglena verrucosa* WISL. — 950:1.
6. *Dictyosphaerium pulchellum* WOOD — 850:1.
7. *Ceratium hirundinella* (O. F. MÜLL.) SCHRANK f. *silesiacum* (SCHROED.) HUB.-PEST. — 600:1.
8. *Pseudokephyrion conicum* SCHILLER — 800:1.
9. *Synura uvella* EHR. — 800:1.
10. *Desmatractum indutum* (GEITL.) PASCH. — 950:1.

Plate II





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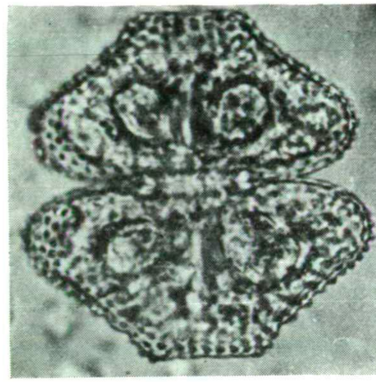

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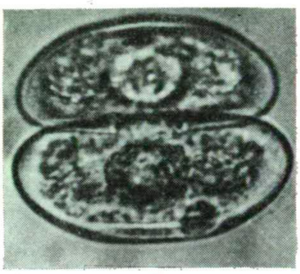

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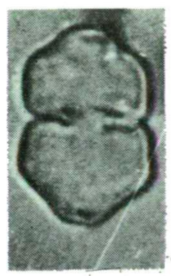

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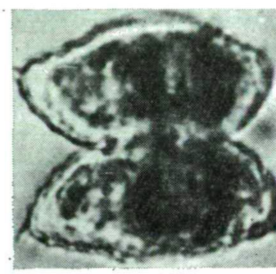

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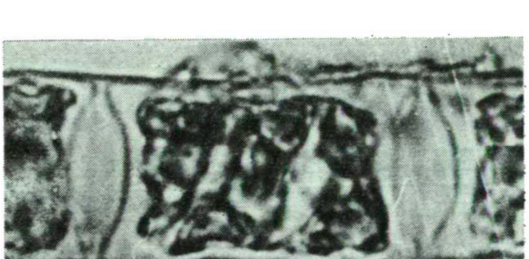

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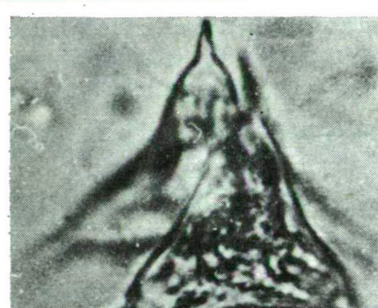

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KORSCH. From the eleven taxons occuoring here eight are members of the *Euglenophyta*. This also shows that the water of the non-protedted area is richer in organic polluting materials.

From the 286 taxons there were thirty-seven that occurred in any bioseston tests both of the protected and the non-protected areas. *Ceratium hirundinella* (O. F. MÜLL.) Schrank appeared with a great variety of forms among which *Ceratium hirundinella* f. *furcoides* (SCHROED.) H. P., *C. hirundinella* f. *silesiacum* (SCHROED.) H. P., and *C. hirundinella* f. *robustum* (BACHM.) H. P. could definitely be distinguished. These are probably characteristic of the majority of the dead arms of the Tisza. *Cosmarium turpini* BRÉB. was similarly found in any water sample but only rerely, and it showed, in spite of the low individual number, a considerable variability in form. Its presence in the dead arms may hardly be general (Plate III, 2). *Desmatractum indutum* (GEITL.) PASCH. represented a very considerable variability in form and size (Plate II. 10). *Synura uvella* EHR. var. *tiszaensis* KISS I. was found as a nova variation. It will be described in a separate paper (KISS, I. 1978).

Water bloom-like mass productions were brought about by five taxons. *Microcystis aeruginosa* f. *aeruginosa* STARMACH, and *M. aeruginosa* f. *flos aquae* (WITTR.) ELENK. caused on September 29, 1976, simultaneously and together, a bluish-grey vegetative colouration in the northern bend of the protected part. *Aphanizomenon flos aquae* (L.) RALFS, about 300 m east from the former one, similarly on September 29, 1976 coloured the water surface dirty bluish-grey. The colouration of mass production could also be observed here on November 3, 1976. On May 28, 1977, similarly in the northern part of the protected area, *Dinobryon sertularia* EHR. drew the attention to itself with a yellowish-greenish water bloom. At the same time, in the neighbourhood of the bend in the protected area, the water surface was spottily vivid green in an extension of several hundred square metres. The vegetative colouration was almost exclusively induced by *Eudorina elegans* EHR. In the southern section of the dead arm in the non-protected area, even rowing was impeded by the masses of *Spirogyra insignis* (HASS.) CZURDA, floating of the surface of the water, on May 18, 1976. The filose parts of this *Spirogyra* brought about a voluminous network under the water as well.

The pH of the water varied both in the protected and non-protected areas between 7,3 and 7,6. Water pollution was, however, very different from place to place. From the water-bloom mass productions which occurred particularly in the northern part belonging to the nature conversation area, we may draw the conclusion that the eutrophic character is more and more increasing.

Plate III

1. *Cosmarium quadrum* var. *sublatum* W. et G. S. WEST — 600:1.
2. *Cosmarium turpini* BRÉB. 650:1.
3. *Cosmarium depressum* (NAEG.) LUND. — 750:1.
4. *Cosmarium wembaerense* SCHMIDLE — 1000:1.
5. *Staurastrum paxilliferum* G. S. WEST — 1000:1.
6. *Pleurotaenium trabecula* (EHR.) NAEG. — 200:1.
7. *Pleurotaenium trabecula* (EHR.) NAEG. — 500:1.
8. *Kephyriopsis ovum* PASCH. et RUTTN. — 2000:1-
9. *Spirogyra varians* (KÜTZ.) CZURDA — 800:1.
10. *Staurastrum omearii* ARCH. — 1400:1.

Tabular 1

No	Species (taxon)	Biotop group „A"							Biotop g. „B"		
		22 VI	16 V	1 VIII	29 IX	3 XI	16 II	28 V	22 VI	18 V	30 XI
		1975	1976				1977		1975	1976	
1.	Phylum: *Cyanophyta* *Microcystis aeruginosa* KÜTZ. *f. aeruginosa* STARMACH (=*f. typica* ELENKIN)	2	2	3	4	3	1	2			
2.	*M. aeruginosa* KÜTZ. f. *flos aquae* (WITTR.) E. (=*M. flos aqae* (WITTR.) KIRCHNER)	2	2	3	4	3	1	2			
3.	*Gomphosphaeria aponina* KÜTZ.	2	1				1		2	2	
4.	*G. lacustris* CHOD.		2	2					2	1	3
5.	*G. naegeliana* (UNGER) LEMM.	1	2	1					2		
6.	*Coelosphaerium naegelianum* UNGER	2	3		2				2		
7.	*Merismopedia punctata* MEYEN			2			1	2	1	2	
8.	*M. tenuissima* LEMM.		2			3	3	2	2	2	
9.	*Aphanocapsa grevillei* (HASS.) RABH.			2					1	2	
10.	*A. sideroderma* NAUMANN	2			1				2	1	
11.	*Dactylococcopsis acicularis* LEMM.		2	2			2			1	
12.	*D. raphidiodides* HANSG.	1	2	2	2	1	1	2	1	3	3
13.	*Tetrapedia gothica* REINSCH	2							2	1	
14.	*T. reinschiana* ARCHER								1	1	
15.	*Anabaena affinis* LEMM.			2	2	1	1	2			
16.	*A. spiroides* KLEBAHN			2	1				3		
17.	*Aphanizomenon flos aquae* (L.) RALFS		2	3	4	4			3		
18.	*Spirulina corakiana* PLAYFAIR		2	1							
19.	*Sp. laxissima* KÜTZ.		2	2	2		2		1	2	2
20.	*Sp. maior* KÜTZ.	2	1	1	1	1	2	2	1	2	2
21.	*Oscillatoria animalis* AGARDH		2	2	2				2	1	
22.	*O. boryana* (AGARDH) BORY		2		2	1				2	
23.	*O. chalybea* MERTENS			3	2	1			1	1	1
24.	*O. formosa* BORY	1			2	2	2	1			

Tabular 1

No	Species (taxon)	Biotop group „A"							Biot. g. „B"		
		22 VI	16 V	1 VIII	29 IX	3 XI	16 II	28 V	22 VI	18 V	30 IX
		1975	1976				1977		1975	1976	
25.	*O. laetevirens* (CROUAN) GOM.		2	1	2					2	
26.	*O. lauterbornii* SCHMIDLE		3		2	2	1				
27.	*O. nigra* VAUCHER		2	2					2	1	
28.	*O. planctonica* WOLOSZ.	1	1	2	2	1	1				
29.	*O. simplicissima* GOM.			2	2	3	2				
30.	*O. tenuis* AGARDH		2	3	3	2	1	1	1	1	1
31.	*O. tenuis f. rivularis* (HANSG.) ELENK.			1	2		2			1	
32.	*Phormidium ambiguum* GOM.		2	2	1				2		
33.	*Ph. corium* (AGH.) GOM.			2	3		2	1		2	
34.	*Ph. favosum* (BORY) GOM.		1	1	2				1		
35.	*Ph. papyraceum* (AGH.) GOM.	2				3	2	2	2		
36.	*Ph. purpurascens* (KÜTZ.) GOM.	3	2		1				2	2	2
37.	*Ph. tenue* (MENEGH.) GOM.		2	2							
38.	*Lyngbya contorta* LEMM.		2						2	3	
39.	*L. cryptovaginata* SCHKORB.		2	2	3				2		
40.	*L. limnetica* LEMM.	1	1	2	2	1	1	2			
41.	*L. martensiana* MENEGH.		1	2	2	2			2	2	
42.	*L. stagnina* KÜTZ.	3	2	1					2	2	
43.	*Schizothrix polytrichoides* FRITSCH		1		2				2	1	
	Phylum: *Euglenophyta*										
44.	*Colacium simplex* HUBER-PEST.	2	3	3	3	3	3	3	2	2	2
45.	*Euglena acus* EHR.	2	1	1	2	2		2	2	3	3
46.	*E. allorgei* DEFL.								2	2	
47.	*E. gasterosteus* SKUJA			2	2				2	3	
48.	*E. chlamydophora* MAINX								2	2	2
49.	*E. gracilis* KELBS	1	2		2				1	1	
50.	*E. limnophila* LEMM.								2	2	2
51.	*E. proxima* DANG.		2	2	2				3	2	

Tabular 1

No	Species (taxon)	Biotop group „A"							Biot. g. „B"		
		22 VI	16 V	1 VIII	29 IX	3 XI	16 II	28 V	22 VI	18 V	30 IX
		1975	1976				1977		1975	1976	
52.	*E. velata* KLEBS								3	2	
53.	*Lepocinclis ovum* (EHR.) LEMM.								2	2	
54.	*L. steinii* LEMM. em. CONRAD								2	1	
55.	*Phacus acuminatus* STOKES		2		1					2	2
56.	*Ph. caudatus* HÜBNER	2		2						2	2
57.	*Ph. longicauda* (EHR.) DUJ.		1			1		1		1	1
58.	*Ph. myersi* SKVORTZ.								2	2	
59.	*Ph. pyrum* (EHR.) STEIN								2	1	2
60.	*Trachelomonas volvocina* EHR.	1		2				1	1	1	
61.	*Tr. intermedia* DANG.				2				2	1	
62.	*T. crebea* KELLICOTT emend. DEFL.	1	1	2	2	1	1	2	2	3	1
63.	*T. granulata* SWIRENKO	2	2	1	2	2	2	1	1	1	2
64.	*T. planctonica* SWIR.	3		2	2	3	3			2	
65.	*T. similis* STOKES					2	1		1	1	
66.	*Strombomonas fluviatilis* (LEMM.)DEFL.		2		2		1			2	
67.	*S. verrucosa* (DADAY) DEFL. Phylum: *Chrysophyta* *Xanthophyceae*	1		2		2			1	2	
68.	*Asterogloca gelatinosa* PASCHER	1						2			
69.	*Chlorobotrys simplex* PASCHER		2	1							
70.	*Centritractus africanus* FRITSCH et RICH			2	3	2					
71.	*C. belonophorus* LEMM.	2		2	2	2					
72.	*C. dubius* PRINTZ			1					2	1	
73.	*Ophiocytium capitatum* WOLLE			2	2	1				1	2
74.	*O. cohleare* A. BRAUN			1	1						
75.	*O. Lagerheimii* LEMM.					2	1		1		2
76.	*Tribonema affine* G. S. WEST		1	2	1	2	1		2	2	
77.	*T. elegans* PASCHER	3	2	1	2	2					2

Tabular 1

No	Species (taxon)	Biotop group „A"							Biot. g. „B"		
		22 VI	16 V	1 VIII	29 IX	3 XI	16 II	28 V	22 VI	18 V	30 IX
		1975	1976				1977		1975	1976	
78.	*T. minus* G. S. WEST	1	2	2	2	2	2	2	1		1
79.	*T. regulare* PASCHER *Chrysophyceae*		2	3	1					2	
80.	*Chromulina freiburgensis* DOFL.			2	3	2					
81.	*Ch. ovalis* KLEBS			2	2	3				3	
82.	*Chrysococcus biporus* SKUJA	2	3	1	3	2	1		1	1	2
83.	*C. rufescens* KLEBS			2	2	1		2		3	
84.	*Chrysoglena verrucosa* WISL.	1	2	2	2	2	1				
85.	*Dinobryon sertularia* EHR.	2	3	3	3	2	2	4	2	2	2
86.	*D. cylindricum* IMHOF.		1	2	2	2	1	3	2	1	1
87.	*D. divergens* IMHOF.	2	2	3	3	2	3	1	1	1	1
88.	*D. tabellariae* (LEMM.) PASCHER	1	1	1	2	1					
89.	*Kephyrion cylindricum* (LACK.) CONR.	1	2	2	3	3	2	1	1	1	1
90.	*K. rubri-claustri* CONR.			2	2	2					2
91.	*Pseudokephyrion conicum* SCHILLER		1	2	2	1	1		3		
92.	*Kephyriopsis ovum* PASCH. et RUTTN.				2	2				1	
93.	*Mallomonas bernardinensis* (CHOD.) CONR.			1	2	1					
94.	*M. caudata* IWANOFF	1	2	2	3	2	2	1	1	1	1
95.	*M. hirsuta* CONRAD			1	2	1			1		
96.	*Ochromonas nasuta* SKVORTZOW	1	1	1	1	2	1			2	
97.	? *Pseudosyncrypta spec.*			1	2	2					
98.	*Synura uvella* EHR.	1	1	2	3	3	2		1	2	
99.	*Synura uvella* EHR. var. *tiszaensis* KISS I.		2	1	3	2	1				2
100.	? *Tessella volvocina* PLAYFAIR *Bacillariophyceae*			1	2						
101.	*Achnanthes affinis* GRUN.		2	1	1	1			1	2	
102.	*A. linearis* W. SMITH		1		1	1			2		
103.	*Amphora commutata* GRUN.			1	2	2	1	2	1	1	1
104.	*A. veneta* KÜTZ.	1	2	2	2	1	2	2	3	3	2

Tabular 1

No	Species (taxon)	Biotop group „A"							Biot. g. „B"-		
		22 VI	16 V	1 VIII	29 IX	3 XI	16 II	28 V	22 VI	18 V	30 IX
		1975	1976				1977		1975	1976	
105.	*Anomoconeis sphaerophora* (KG.) PFITZ.	2	2	1	1				2	2	
106.	*Asterionella formosa* HASS.	1	1	2	2	2		2	2		
107.	*A. zasuminensis* (CABEJSZ.) LUNH-ALM.			2	3	3	1		2		1
108.	*Bacillaria paradoxa* GMELIN	1	2	2	2	2	1	1		2	
109.	*Caloneis amphisbaena* (BORY) CL.	2	2	2	3	3	2	2	3	3	2
110.	*Cocconeis pediculus* EHR.	1	2	2	2		1	2			
111.	*C. placentula* EHR.	1	2	3	3	1	2	1		2	
112.	*Cyclotella comta* (EHR.) KÜTZ.	2	1	2	2	2	1	2	1		1
113.	*C. meneghiniana* KÜTZ.	3	2	2	3	3			2	2	2
114.	*Cymatopleura elliptica* (BREB.) W. SMITH		2	1					1		1
115.	*C. elliptica var. hibernica* (W. SMITH) HUST.	1	1		2		1		1	2	1
116.	*C. solea* (BRÉB.) W. SMITH	1	1	1	1	1	1	1	2	3	2
117.	*Cymbella affinis* KÜTZ.	1	1	2	2	1	1	2	1	1	1
118.	*C. austriaca* GRUNOW	2		2		2		1	2	2	
119.	*C. lanceolata* (EHR.) VAN HEURCK	1	1	1	1	2	2	1	2	2	1
120.	*C. cymbiformis* (KÜTZ.) VAN HEURCK	1	1	2	2	2	1	1	2	2	2
121.	*C. ventricosa* KÜTZ.			2	2		2			2	
122.	*Diatoma elongatum* (LYNGB.) AG.		1	2	2	2			1		1
123.	*D. hiemale* (LYNGB.) HEIBERG	2		2			1		2	2	
124.	*D. vulgare* BORY	1	2	2				1	2	1	1
125.	*Epithemia turgida* (EHR.) KÜTZ.				2		2		1	2	2
126.	*Eunotia lunaris* (EHR.) GRUN.		2			2			2	2	
127.	*Fragilaria capucina* (DESM.)	1	1	1	2	2	2	1		1	
128.	*F. virescens* RALFS				2	1	1		2		
129.	*F. virescens var. mesolepta* SCHÖRF.			2						1	
130.	*Gomphonema acuminatum* EHR.		1	1	3	2	1		2		2
131.	*G. acuminatum var. trigonocephalum* (EHR.) GRUNOW	1	1	1	2	1				2	
132.	*G. augur* EHR.			1	2	2	1		1		

Tabular 1

No	Species (taxon)	Biotrop group „A"							Biot. g. „B"		
		22 VI	16 V	1 VIII	29 IX	3 XI	16 II	28 V	22 VI	18 V	30 IX
		1975	1976				1977		1975	1976	
133.	*Gyrosigma acuminatum* (KÜTZ.) (RABENH.)		2	2				1	2	3	
134.	*G. kützingii* (GRUN.) CL.	2	2	2	1	1					1
135.	*Hantzschia amphioxys* (EHR.) GRUN.		2		1			1	2	2	
136.	*Melosira granulata* (EHR.) RALFS		1	1	2	1					
137.	*M. varians* AGARDH			2	2	2	2	2			
138.	*Navicula cryptocephala* KÜTZ.	2	2		1				2	1	
139.	*N. exigua* (GREG.) O. MÜLL.		2				1		2	2	
140.	*N. gregaria* DONK.	1	1		2			2	2	3	3
141.	*N. radiosa* KÜTZ.	1	1	2	1	1	2	1	2	1	
142.	*N. rhynchocephala* KÜTZ.		1	2					2	2	3
143.	*N. ventralis* KRASSKE	2				2			3	3	1
144.	*Neidium productum* (W. SMITH) CLEVE		2	2	2	2				3	
144.	*Nitzschia apiculata* (GREG.) GRUN.		2				1		2	2	
146.	*N. gracilis* HANTZSCH.	1	1	2	2	2	2	2	2	1	1
147.	*N. hantzschiana* RABH.			3	2					1	
148.	*N. hungarica* GRUN.	2	2	2	3	2		2		1	
149.	*N. kützingiana* HILSE				2	2			2	2	
150.	*N. linearis* W. SMITH	1	1	2	3	2	2		2		
151.	*N. palea* (KÜTZ.) W. SMITH		2	2	2	1		2		2	1
152.	*N. sigmoidea* (EHR.) W. SM.	1	1	1	2	2	2		1		1
153.	*Pleurosigma elongatum* W. SMITH		2	2							
154.	*Rhoicosphaenia curvata* (KÜTZ.) GRUN.		2	1					2		
155.	*Rhopalodia gibba* (EHR.) O. MÜLL.		2	3					2	2	
156.	*Stauroneis anceps* EHR.					1		1	2	2	
157.	*Surirella biseriata* var. *bifrons* (EHR.) HUST.		2	2						1	
158.	*S. linearis* var. *constricta* (EHR.) GRUN.	1	1	1	1	2					1
159.	*S. ovalis* BRÉB.			2	2	2	1	2		2	
160.	*S. ovalis* KÜTZ.	2	1	2					1		

Tabular 1

No	Species (taxon)	Biotop group „A"							Biot. g. „B"		
		22 VI	16 V	1 VIII	29 IX	3 XI	16 II	28 V	22 VI	18 V	30 IX
		1975	1976				1977		1975	1976	
161.	Phylum: *Pyrrophyta* *Ceratium hirundinella* (O. F. MÜLL.) SCHRANK	1	2	3	2	2	2	2	1	1	1
162.	*C. hirundinella f. furcoides* (SCHROED.)										
163.	HUBER-PEST. *C. hirundinella* f. *silesiacum* (SCHROED.) H. P.	1	2	3	3	3	1	2	1	2	1
164.	HUBER-PEST. *C. hirundinella* f. *robustum* (BACHM.)										
165.	HUBER-PEST. *Cystodinium bisetosum* (LINDEM.)	1	1	1	3	1	2	2	1	2	1
166.	*Glenodinium edax* SCHILLING				1	2	2	2	2	1	1
167.	*Gonyaulax apiculata* (PENARD) ENTZ			1	2						
168.	*Gymnodinium veris* LINDEM.		1			1	2	1		1	
169.	*Peridinium bipes* f. *globosus* LINDEM.			1	1				1		
170.	*P. cinctum* (MÜLLER) EHR.	1	1	2	3	1	1	1	1	1	1
171.	*P. palatinum* LAUTERB.	1	2	1	3	3	3	1	1	1	2
172.	*P. palatinum* f. *anglicum* (G. S. WEST) LEF.			1	2	2	2	2	1	1	1
173.	*P. volzii* LEMM.	1	2	2	3	3	2	1	1	1	1
174.	*P. volzii* var. *cinctiforme* LEF.			2	2	2	1				
175.	*Peridinium spec.*		1	2	2	2	2	1		1	
176.	Phylum: *Chlorophyta* *Chlorophyceae* *Actinastrum hantzschii* LEMM.		2		1	1	1		2	2	2
177.	*Ankistrodesmus acicularis* (A. BRAUN) KORSHIKOV	1	2						2	2	1
178.	*A. falcatus* (CORDA) RALFS	1	1	2	2	2	2	1	2	2	3
179.	*A. convolutus* CORDA			2		3			2	2	2
180.	*A. pseudomirabilis* KORSH.	1	1	2	2					1	
181.	*Characium hookeri* (REINSCH) HANSG.	2	2	1	1				1		
182.	*C. sieboldii* A. BRAUN	2				1			2	3	
183.	*Chlorella infusionum* (SCHRANK) MENEGH.		2				2		2	3	

Tabular 1

No	Species (taxon)	Biotop group „A"							Biot. g. „B"		
		22 VI	16 V	1 VIII	29 XI	3 XI	16 II	28 V	22 VI	18 V	30 IX
		1975	1976				1977		1975	1976	
184.	*Chlorococcum humicolum* (NAEG.) RABH.								1	1	1
185.	*Chodatella octoseta* ALTEN			1					2	1	
186.	*Coelastrum cambricum* ARCH.		2	3					2	2	1
187.	*C. microporum* NAEG.	2	2	2	2	2	3	1	1	1	1
188.	*C. sphaericum* NAEG.			1	2	2				1	
189.	*Chodatellopsis elliptica* KORSH.		1				1		2	1	
190.	*Crucigenia rectangularis* (NAEG.) GAY.	1			2	2			3	3	2
191.	*C. quadrata* MORREN		3	2	1					1	
192.	*C. terapedia* (KIRCHN.) W. et G. S. WEST						1	1	2	2	
193.	*Desmatractum indutum* (GEITL) PASCH.	1	2	2	2	1	1		1		
194.	*D. bipyramidatum* (CHOD.) PASCHER			1	2	3	1				
195.	*Dictyosphaerium pulchellum* WOOD	1	1	2	2	3	3	1	1	1	1
196.	*Didymogenes palatina* SCHMIDLE	1		2				1	1	2	
197.	*Dimorphococcus lunatus* A. BR.							1	2	2	
198.	*Elakothrix acuta* PASCHER		1			1			2	2	
199.	*E. lacustris* KORSH.	1							1	2	1
200.	*Eremosphaera gigas* (ARCHER) FOTT et KALINA				1				2	2	
201.	*Eudorina charkowiensis* PASCHER		2	1		2				2	
202.	*E. elegans* EHR.	2	2	3	3	3	2	4	2	2	2
203.	*Franceia ovalis* (FRANCÉ) LEMM.						1		2	2	2
204.	*Fusola viridis* SNOW		1						2	2	
205.	*Gloeoactinium limneticum* G. M. SM.							1		2	1
206.	*Golenkinia radiata* CHODAT		2				2		2	1	
207.	*Kirchneriella contorta* (SCHMIDLE) BOHL.		1	2		1			2	2	2
208.	*K. obesa* (W. SMITH) SCHMIDLE	2	2	2	2	2	2	2	2	3	2
209.	*Lagerheimia genevensis* CHODAT			1	2						1
210.	*Nephrochlamys allantoidea* KORSH.								1	2	1
211.	*N. subsolitaria* (G. S. WEST) KORSH.			1	2	2			2	2	

Tabular 1

No	Species (taxon)	Biotop group „A"							Biot. g. „B"		
		22 VI	16 V	1 VIII	29 IX	3 XI	16 II	28 V	22 VI	18 V	30 IX
		1975	1976				1977		1975	1976	
212.	*Nephrocytium agardhianum* NAEG.		2				1		1	2	
213.	*N. allantoideum* BOHL.			2	2	2		2	1	1	1
214.	*Oocystis borgei* SNOW	1	2				2				1
215.	*O. elliptica* W. WEST	2	2	1	2	3				1	
216.	*O. natans* (LEMM.) WILLE.		3	2	3	1			1		
217.	*Pediastrum boryanum* (TURP.) MENEGH.	2	1	2	2	2		2	1	2	2
218.	*P. duplex* MEYEN	1	1	3	2	1	1	1	1	1	1
219.	*P. simplex* MEYEN	1	1	2	3	3	2	1	1	1	1
220.	*P. tetras* (EHR.) RALFS	1	1	2	1	2	1	3	2	1	2
221.	*Polyedriopsis spinulosa* SCHMIDLE	2	2	3	3	3		2	2	2	2
222.	*Quadrigula chodatii* (TAN.-FUL.) G. N. SM.		1						2	2	
223.	*Scenedesmus acuminatus* (LAGERH.) CHODAT	1	2	2	2	3	1	1	1	2	1
224.	*Sc. acuminatus* var. *elongatus* G. M. SMITH		2	1							
225.	*Sc. acutus* MEYEN				2	2			1	2	
226.	*Sc. acutus* f. *alternans* HORTOB.					2			2	2	2
227.	*Sc. acutus* f. *costulatus* UHERKOV.	2		2				1	2	2	
228.	*Sc. bicaudatus* (HANSG.) CHODAT		2	3	1			1			1
229.	*Sc. bicaudatus* var. *brevicaudatus* HORTOB.			2	2	1			1		
230.	*Sc. denticulatus* LAGERH.	2				2	2	2			1
231.	*Sc. denticulatus* var. *linearis* HANSG.			2		2	2			1	
232.	*Sc. denticulatus* var. *polydenticulatus* HORTOB.					2	1		2		
233.	*Sc. dispar* BRÉB.	3	2	2				2	2	2	
234.	*Sc. ecornis* (RALFS) CHODAT	1	1	1	2	3	2	1	1	1	1
235.	*Sc. ecornis* var. *disciformis* CHOD.	1	2			1				1	
236.	*Sc. intermedius* CHODAT			2	2					2	
237.	*Sc. opoliensis* P. RICHT.	1	1	1	2		2				2
238.	*Sc. ovalternus* CHODAT		1	1	3	2			2		
239.	*Sc. quadricauda* (TURP.) BRÉB.	1	2	2	2	2	3	2	3	3	1

Tabular 1

No	Species (taxon)	Biotop group „A"							Biot. g.„B"		
		22 VI	16 V	1 VIII	29 IX	3 XI	16 II	28 V	22 VI	18 V	30 IX
		1975	1976				1977		1975	1976	
240.	*Sc. quadricauda* var. *biornata* KISS		1	2	3	2			2	2	
241.	*Sc. quadricauda* var. *quadrispina f. gracillimus* UHERKOV.	1	1	1	2	2			1	2	
242.	*Sc. securiformis* PLAYF.		2	3	2			2			1
243.	*Sc. spinosus* CHODAT			1	1	2	2			1	1
244.	*Schroederia setigera* (SCHRÖD.) LEMM.	3	2								
245.	*Sch. spiralis* (PRINTZ.) KORSH.	1	1	2							
246.	*Siderocelis ornata* FOTT		2	2	2				1	1	
247.	*Sorastrum spinulosum* NAEG.				3	2			2	2	
248.	*Sphaerocystis polycocca* KORSH.	1	1	2		2		2		3	
249.	*Sph. schroeteri* CHODAT		1	2	2	2			2	2	2
250.	*Tetraedron caudatum* (CORDA) HANSG.			2	1					1	
251.	*T. minimum* (A. BRAUN) HANSG.	1	1	1	1	2	2	2		2	1
252.	*T. minimum* var. *apiculatum* REINSCH	1	1	2	2				3	1	
253.	*T. muticum* (A. BRAUN) HANSG.		2				2		2	3	2
254.	*T. regulare* KÜTZ.	1	1			1			1	1	
255.	*T. trigonum* (NAEG.) HANSG.			1	2						2
256.	*T. trilobatum* (REINSCH) HANSG.		1			1	1	1	1	2	
257.	*Tetrallantos lagerheimii* TEIL.	1		2					2	1	
258.	*Tetrastrum staurogeniaeforme* (SCHRÖD.) LEMM.	2	2	1	1	1			3	2	
259.	*T. triacanthum* KORSH.		1		2	1	1		1	2	1
260.	*Treubaria varia* TIFF. et AHLSTR.		2	1				1	2	1	
261.	*Trochiscia granulata* (REINSCH) HANSG.	1				1			1	2	
262.	? *T. aciculifera* (LAGERH.) HANSG.				2	3	2		1		
263.	*Hormidium fluitans* (GAY) HEERING		2					1	2	3	
264.	*Oedogonium capilliforme* KÜTZ. sec. HIRN		2							3	
265.	*Stigeoclonium lubricum* KÜTZ.				3		2		2	2	
266.	*Ulothrix tenuissima* KÜTZ.			2	3	3	2	1	3	3	1

Tabular 1

No.	Species (taxon)	Biotop group „A”							Biot. g. „B”		
		22 VI	16 V	1 VIII	29 IX	3 XI	16 II	28 V	22 VI	18 V	30 IX
		1975	1976				1977		1975	1976	
267.	*Cladophora fracta* KÜTZ. ampl. BRAND							3	2	3	
268.	*Conjugatophyceae* *Closterium acerosum* (SCHRANK) EHR.	1	2	3	3	1			2	2	2
269.	*Cl. aciculare* T. WEST			2	2						1
270.	*Cl. lanceolatum* KÜTZ.	1	2	2	1	1	3	3	2	2	2
271.	*Cl. leibleinii* KÜTZ.			3	2	2	2	2	1	1	1
272.	*Cl. moniliferum* (BORY) EHR.	2	3	1	2	1			2	1	1
273.	*Pleurotaenium trabecula* (EHR.) NAEG.			1	2	2	1			2	
274.	*Cosmarium depressum* (NAEG.) LUND.	1	1	2	3	1	1		1	1	
275.	*C. margaritiferum* MENEGH.	1	1	1	2	1	1	1	1	1	1
276.	*C. quadrum var. sublatum* (NORDST.) W. et G. S. WEST	2	3	2	2	2	2	2	2		
277.	*C. turpini* BRÉB. (var. ?)	1	1	1	2	3	2	1	1	1	1
278.	*C. wembaerense* SCHMIDLE		2	3	1	1			3	3	1
279.	*Staurastrum omearii* ARCH.			1	2			2			
280.	*St. paxilliferum* G. S. WEST		1		1	2	2		2		
281.	*Spirogyra areolata* LAGERHEIM	3	2							3	
282.	*Sp. insignis* (HASS.) CZURDA		3					3		4	
283.	*Sp. varians* (KÜTZ.) CZURDA	3			3				3		
284.	*Mougeotia angusta* HASSAL			3			3			3	
285.	*M. sphaerocarpa* WOLLE	2	3			2					2
286.	*Gonatozygon pilosum* WOLLE				2				3	2	

References

ASMUND, B. & HILLIARD, D. K. (1957): Studies on Chrysophyceae from some ponds and lakes in Alaska. I. — Hydrobiol. *17*, 237—258.

BOURELLY, P. (1957): Recherches sur les Chrysophycées. — Rev. Algol. Mém. Hors-Série *1*, 1—412.

BRADLEY, D. E. (1964): Study of the *Mallomonas, Synura* and *Chrysosphaerella* of Northern Iceland. — J. gen. Microbiol. *37*, 321—333.

BRUNNTHALER, J. (1930): Protococcales. Pascher' s Süßw. *5*, 52—205.

CHOLNOKY, B. J. (1960): Beiträge zur Kenntnis der Ökologie der Diatomeen in dem Swartkops-Bache nahe Port Elizabeth (Südost-Kaapland). — Hydrobiol. *15*, 229—287.

CHOLNOKY, B. J. (1964): Die Diatomeenflora einiger Gewässer der Ruwenzori-Gebirge in Zentral-afrika. — Nowa Hedwigia *8*, 55—101.

CHOLNOKY, B. J. (1968): Die Diatomeenassoziationen der Santa-Lucia-Laguna in Natal (Südafrika). — Botanica Marina XI. (Suppl.), 7—121.

CHOLNOKY, B. J. (1970): Die Diatomeenassoziationen im Nonoti Bach in Natal (Südafrika). — Nowa Hedwigia, Heft 31, 313—329.

CHOLNOKY—KÄTHE PFANNKUCHE (1965): Protoplasmatische Untersuchungen an Salz- und Süß-wasserdiatomeen. — Protoplasma *60*, 345—354.

CLEVE-EULER, A. (1951—1955): Die Diatomeen von Schweden und Finnland, I—V., Stockholm.

COMERE, J. (1901): Les Desmidiées de France. Libraire des Sciences Naturelles. — Paris. 1.

CONRAD, W. (1939): Sur quelques Chrysomonadines du nannoplankton de Rouge Cloitre. — Bull. Hist. Nat. Belg. *15*, 1—10.

CZURDA, V. (1932): Zygnemales. — Pascher's Süßw. *9*, 1—232.

ERGASHEV, A. E. (1976): Zakonomernosti razvitiya i raspredelniya algoflori v iskustvennikh vodo-emakh srednei Azii. — Akad. Nauk. Uzbekskoy S. S. R., Otdel Mikrobiologii, Tashkent, 1—358.

FELFÖLDY, L. (Ed.): BARTA, ZS., FELFÖLDY, L., HAJDÚ, L., HORVÁTH, K., KISS, K., SCHMIDT, A., TAMÁS, G., UHERKOVICH, G., VÖRÖS, L. (1976): A zöldalgák rendjének (Chlorococcales) kis-határozója. (Small determinator of the order of green algae). — Vízügyi Hidrobiológia *4*, 3—343.

FJERDINGSTAD, E. (1965): Taxonomy and Saprobic Valency of Benthic Phyto-micro-organisms. — Internat. Revue der Gesamten Hydrobiologie *4*, 475—603.

FOTT, B. (1952): Mikroflora oravskych resalin. — Preslia *24*, 189—209.

FOTT, B. (1972): Chlorophyceae (Grünalgen), Ordnung: Tetrasporales. — Die Binnengewässer, Band 16, 6. T., 1—116, Plates 1—47.

GEITLER, L. (1925): Cyanophyceae. — Pascher's Süßw. *12*, 481.

GORYUNOVA, S. V., RZHANOVA, G. I., ORLEANSKY, V. K. (1969): Sinezelenie vodorosli. — Akad. Nauk. S. S. S. R., 3—193.

HEERING, W. (1914): Ulotrichales. — Pascher's Süßw. *6*, 9—145.

HEERING, W. (1921): Siphonocladales, Siphonales. — Pascher's Süßw. 7, 1—103.

DEDUSENKO-SEGOLEVA, N. T. & HOLLERBACH, M. M. (1962): Xantophyta. — Opred. Presnov. Vod. U. S. S. R. *5*, 7—272.

HOLLERBACH, M. M. & SHTINA, E. A. (1969): Rosvennie vodorosli (Soil algae). — Akad. Nauk. U. S-S. R. Leningrad, 1—228.

HORTOBÁGYI, T. (1939): Qualitative Untersuchungen des Phytoplanktons des Toten Armes "Nagyfa" der Tisza. — Folia Crypt. 3/2. 151—216.

HORTOBÁGYI, T. (1941): Újabb adatok a Tisza Nagyfa-holtága fitoplanktonjának kvalitatív vizsgálatához I (Recent data on the qualitative investigation into the phytoplankton of the Tisza Dead-Arm at Nagyfa I). — Bot. Közl. *28*, 151—170.

HORTOBÁGYI, T. (1942): Újabb adatok a Tisza Nagyfa-holtága fitoplanktonjának kvalitatív vizsgálatához II (Recent data on the qualitative investigation into the phytoplankton of the Tisza Dead-Arm at Nagyfa II). — Bot. Közl. *29*, 271—276.

HUBER-PESTALOZZI, G. (1938): Blaualgen, Bakterien, Pilze. — Das Phytoplankt. des Süßw., 1—342.

HUBER-PESTALOZZI, G. (1941): Chrysophyceen, Farblose Flagellaten, Heterokonten. — Das Phytopl. des Süßw. *2*, 4—365.

HUBER-PESTALOZZI, G. (1942): Diatomeen. Das Phytopl. des Süßw. *2* ,23—549.

HUBER.PESTALOZZI, G. (1950): Cryptophyceen, Chloromonadinen, Peridineen. — Das Phytopl. des Süßw. *3*, 1—310.

HUBER-PESTALOZZI, G. (1955): Euglenophyceen. Das Phytopl. des Süßw. *4*, 1—606.

HUSTEDT, FR. (1930): Bacillariophyta (Diatomeae). — Pascher's Süßw. *10*, 1—466.

KISS, I. (1961): A *Chlorella*-ciklus fellépése a *Kirchneriella* és az *Ankistrodesmus* egyedi fejlődésében

(Appearance of the *Chlorella* cycle in the individual development of *Kirchneriella* and *Ankistrodesmus*). — Szegedi Ped. Főisk. Évk. 63—75.

KISS, I. (1978): Occurrence of *Synura uvella* EHR. var. *tiszaensis* n. var. in the dead arm of the river Tisza near Lakitelek. Tiscia (Szeged) 13, 49—54.

KOL, E. (1925): Előmunkálatok a Nagy Magyar Alföld moszatflórájához I (Preliminary studies to the algal flora of the Great Hungarian Plain I). — Folia Crypt. (Szeged) *1*, 65—88.

KOL, E.: (1931): Előmunkálatok a Nagy Magyar Alföld moszatvegetációjához II (Preliminary studies to the algal vegetation of the Great Hungarian Plain II). — Acta Biol. (Szeged) *2*, 46—62.

KORSHIKOV, A. A. (1929): Studies on the *Chrysomonads* I. — Arch. f. Prontistek. *67*, 253—290.

KORSHIKOV, A. A. (1953): Protococcineae: Vacuolales, Protococcales. — Akad. Nauk. Ukr. *5*, 1—439.

KRISTIANSEN, J. (1969): *Chrysosphaerella multispina* BRADLEY and some other remarkable Chrysophyceae from Lake Straken Aneboda Sweden. — Österr. Bot. Z. *116*, 70—84.

LUND, J. W. G. (1942): Contributions to our knowledge of British Chrysophyceae. — New. Phytol. *41*, 274—292.

MATWIENKO, O. M. (1965): Chrysophyta. — Vizn. Pris. Vod. Ukr. *3*, 5—367.

MUZAFAROW, A. M. (1965): Flora vodorosley vodoemow sredney Azii, Tashkent, Izd-wo "Nauka".

PANKOW, H. (1963): Bemerkung zur Ökologie von *Synura uvella* E. — Österr. Bot. Zeitschrift *110*, 410—416.

PÁKH, E. (1933): Daten zur Mikrovegetation des Szentmihályteleker toten Tisza-Armes. — Acta Biol. (Szeged) *2*, 233—236.

PÉTERFI, L. S. (1965): Observations of Synura Ehrenb. in Rumania with special attention to *Synura splendida* KORSH. — Rev. Algol. 1965, 52—55.

POPOVA, T. G. (1966): *Trachelomonas, Strombomonas, Eutreptia, Euglena.* — Flora Sporov. Rast. U. S. S. R. *8*, 5—411.

POPOVA, T. G., & SAFONOVA, T. A. (1976): Evglenovie vodorosli (Euglenophyta: *Lepocinclis, Monomorphina, Phacus, Ascoglena, Cryptoglena, Petalomonas, Calycimonas, Rhizaspis*). — Flora Sporov. Rast. U. S. S. R. *9*, 5—287.

PORYADINA, S. N. (1975): Algaflora pritokov reki Ural. — Vodorosl. grubi Sred. Azii, V. 2. Akad. Nauk. Uzbekskoy S. S. R., 78—88.

ROSA, K. (1941): Die Algen des Schwarzen Sees und der Seewand im Böhmerwalde. — Studia Botanica Cehica *4*, 1—16.

ROSA, K. (1951): Algenflora von Südböhmen. — Studia Botanica Cehoslovaca *13/3*, 173—232.

RUZIČKA, J. (1972): Die Zieralgen der Insel Hiddensee. The Desmids from the Island Hiddensee. — Arch. f. Protistenkunde 114, 453—485.

SHTINA, E. A. (1967): Itogi i zadatchi experimentainikh issledovaniy v rosvennoy algologii. — Sovr. sostoyanie perspektivi iz rosv. vod. U. S. S. R., Kirov, 3—22.

SIEMINSKA, J. (1964): Bacillariophyceae okrzemki. — Flora Slodkow. Polski *6*, 5—610.

SKUJA, H. (1956): Taxonomische und biologische Studien über das Phytoplankton schwedischer Binnengewässer. — Nova Acta Soc. Sci. Upsal. *4*, *16/3*, 1—404.

STARMACH, K. (1966): Cyanophyta-Sinice, Glaucophyta-Glaukofity. — Flora Slodkow. Polski *2*, 5—806.

SZABADOS, M. (1940): Szentmihálytelek "Holt-Tisza" ága Flagellata és Volvocales vegetációja II. (Flagellata and Volvocales vegetation of the Tisza Dead Arm at Szentmihálytelek II). — Bot. Közl. *37*, 48—65.

SZEMES, G. (1947): Ökologische Untersuchungen über die Bacillariophyten-Flora des Zagyva-Flusses. — Borbásia *7*, 70—121.

SZEMES, G. (1957): Die Diatomeen des Balatonsees. — Annal, Inst. Biol. (Tihany). Hung. Acad. Scient. *24*, 193—270.

TEMNISKOWA-TOPALOWA, D. (1966): Über die Flora von Euglenophyta und Volvophyceae in Bulgarien III. — Annuaire de l'Univ. de Sofia *59*, 43—57.

UHERKOVICH, G. (1958): Das Leben der Tisza VI. Mallomonas Arten aus der Tisza und einem "Toten Arm" der Tisza. — Acta Biol. (Szeged) *4*, 167—171.

UHERKOVICH, G. (1959): Adatok a Tisza holtágainak mikrovegetációjához I. A szolnoki Tisza holtágainak algái 1957 őszén. (Data on the microvegetation of the Tisza Dead Arms I. Algae of the Tisza Dead Arms at Szolnok, in the Autumn of 1957). — Bot. Közl. *48*, 30—40.

UHERKOVICH, G. (1963): Adatok a Tisza Holtágainak mikrovegetációjához II. A szolnoki Holt-Tisza fitoplanktonjának mennyiségi viszonyai (Data on the microvegetation of the Tisza Dead Arms II. Quantitative relations of the phytoplankton of the Tisza Dead Arm at Szolnok). — Bot. Közl. *50*, 117—124.

WODENITSCHAROFF, D. (1962): Hydrobotanische Untersuchungen über das Urdino-kar (N—W Rila—Gebirge). Annuaire de l'Université de Sofia, *54—55*, 141—211.

WODENITSCHAROFF, D., DRAGANOV, ST., & TEMNISKOVA, D. (1971): Vodorasli. — Flora na Bulgaria "Narodna Prosveta", 5—641.

WEST, W. & WEST, G. S. (1904, 1905, 1908, 1911): A Monograph of the British Desmidiaceae, I—IV, London (Printed for the Ray Society).

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OCCURRANCE OF SYNURA UVELLA EHR. VAR. TISZAENSIS N. VAR. IN THE DEAD ARM OF THE RIVER TISZA NEAR LAKITELEK

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Abstract

This paper reports on a new *Synura* variation from the Tisza Dead-Arm at Lakitelek, named *Synura uvella* EHR. n. var. *tiszaensis*, after the river Tisza. Apart from the characteristic morphological conditions of cells, the development of the colony is also discussed in detail.

Introduction

The *Synura* genus, established by EHRENBERG in 1838, has already been treated by several research workers. HUBER—PESTALOZZI (1941) mentioned in his comprehensive work primarily the activity of KORSHIKOV, BIORET, CONRAD, KLEBS, LEMMERMANN, PETERSEN, SCHILLER, and G. M. SMITH, emphasizing the recognition of KORSHIKOV and BIORET concerning the taxonomical importance of the squamous structure of the cell-membrane. The taxonomical role of silica scales was recently treated by B. FOTT and J. LUDVIK (1957), as well. The most important morphological conditions were presented with electron-microscopical investigation by J. KRISTIANSEN (1969) and E. TAKAHASHI (1959, 1961, 1964). From taxonomical, phylogenetical and ecological points of view, also the investigations of BOURELLY (1957), FOTT (1952), MACK (1951), PANKOW (1963), and PÉTERFI (1965) are recently outstanding.

In the course of investigating the algal flora of the Tisza Dead-Arm on the confines of the community Lakitelek (County Bács-Kiskun), I have found two *Synura* taxons. One of these is *Synura uvella* EHR., and the other a variation of this, differring from the type of the species in more than one particularity. As this new variation was found in the water of the river Tisza, I considered as justified to designate it, after this river, with the name of *Synura uvella* EHR. var. *tiszaensis* n. var. The development of the colony is also shown by means of photomicrographs, making the knowledge of the genus possibly more complete in this way.

Materials and Methods

On the basis of bioseston samples, taken on more than one occasion, I have continuously followed with attention the structure and development of colonies, the morphological conditions and development of cells, as well as the phenomena of multiplication. The ecological conditions were investigated for making the cultures, as well.

Results

The most striking morphological characteristic of the well-developed cells of *Synura uvella* EHR. n. var. *tiszaensis* KISS I. is the comparatively large size and the peculiar size-proportion the help of which it can be well distinguished from other *Synura* taxons. The apical part of the well-developed cell is in front broadly rounded, ovoid, from which a suddenly narrowing, comparatively long, peduncular basal part protrudes. The cells isolated from a well-developed colony may be compared to peduncular club (Fig. 1d). Such cells are 45—55μm long, and, in their apical part, 12—16 μm broad. The two brownishgreen chromatophores take place in the apical part, without reaching down into the basal part. The basal part is generally longer than the apical one. One of the flagella is sowehat shorter. Both in the apical and the basal parts there are to be found some vacuoles; the stigma is missing.

The cell-membrane is covered from the outside with silica scales of varying shapes. In the apical part, these are roundish or broadly oval; in the basal part, they are more elongated. Their length is 2—4 μm, their breadth somewhat smaller. Their spine is short, straight or slightly curved (Fig. 1f). The fallen transitory scale-forms are also frequent (Fig. 1g). In the apical part of the marginal cells of colonies the scales can be observed with the light-microscope as well. The scales in the basal stipiform part are sparser, perhaps because of the additional extension of the peduncle.

Multiplication. Only the cell division could be observed. The division is always longitudinal and the cells in the colony are, therefore, always arranged close side by side, radially towards every direction of the space (Fig. 1e). The multipli-

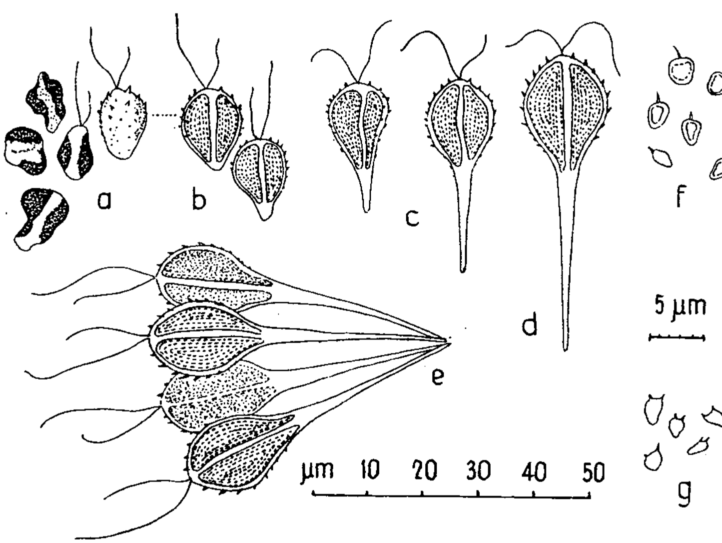


Fig. 1. a. cells of zoospore character,
b. ovoid cells with membrane,
c. cells with a short basal part,
d. cells with a fully developed, long, penduncular part,
e. cell-bundle prepared from a fully developed colony,
f. scale-forms,
g. transitory scales.

cation with zoospores could also be observed: at least one of the progeny-cells presses itself out of the membrane of the mother-cell. For a while its motion is amoeboid, although it has some flagel la or, at least, these appear early. Sometimes both zoospores depart. The zoospores soon loose their amoeboid form and become young cells of oval form, still without any pedicle but with a scaled membrane (Fig. 1a—b). By the additional extension of the basal part, short-pediculated, cells are formed at first then after further extension long pediculated (Fig. 1c—d).

In the bioseston and the cultures, we could study the formation of colonies, too. Trough investigation of the colony formation, a drfinite phasic character could be observed in the ontogeny of this organisms. The succession of these is under the considerable influence of the environmental factors. A definite sequence, applicable to the whole process of development, could therefore not be established.

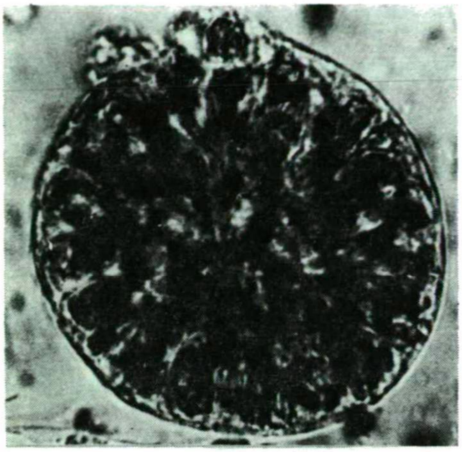
The phase of forming the gallert-envelope, shown by photo micrograph 1, Table I, seems to be the most striking. The cells of the spherical colony with a somewhat larger than 80 μm diameter are embedded in a gallert-envelope on the surface of which a massive, "skinlike" layer has been formed. The thickness of this has mostly reached even 3—4 μm. This phase seemed to be frequent enough, and this is such a feature which has not appeared in the case of the other *Synura* taxons to such an extreme extent. In this phase, the cells embedded in the gallert-mass are still rather oval, and their definite pediculate basal part vas not formed yet. Their arrangement is, however, already here, obviously radial towards every direction of the space. At the upper margin of the colony, the solid outer layer of the gallert-envelope is already "dissolved" and zoospore-like, to some extent still amoeboid cells press themselves out of the bonds of the colony. A "dissolution", like this, and a protrusion of zoospores, could sometimes simultan eously be observed at many points of the colonies. A bursting of the solid outer layer could never be observed. This outer, solid, coagulative gallert-layer seems to pass away gradually getting into a dispersed state. All these can probably be attributed to the enzymatic, active functioning of cells.

A newer phase may be represented by the state in which the outer solid layer of the gallert-mass has already completely disappeared. Then the cells of the colony have already got into a looser state and more and more cells, primarily those of zoospore-character, are released from the colonial bonds. An initial state of this is shown by photomicrograph 2, Table 1. The gallert-mass of the colonies in a state like this is already partially of disperse substance, the cell-mass comes into a commotion, and the cells can even leave their places to some extent. In the upper part of photomicrograph 2, one of the cells is just leaving and it is apparently still of amoeboid character, *i. e.* a zoospore. In the case of the marginal cells, the flapping flagella are also palely visible. Colonies like this are either transformed completely into swarming cells or dissolved into smaller or larger successor-colonies. Then the new groups of the loosened cells induce new colonies of a solid cell substance.

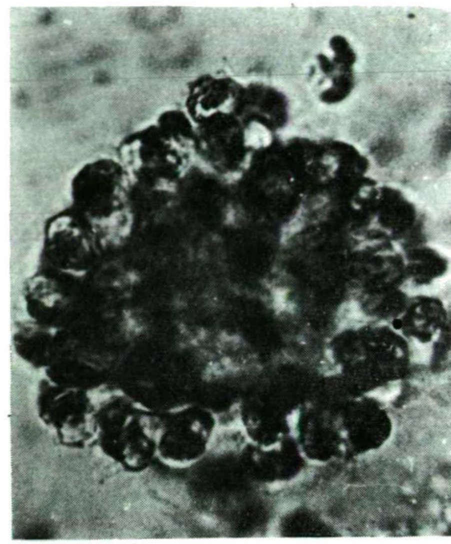
I could so far distinguish two forms of the beginnings of forming new colonies. These are:

1. Formation of loose colonies consisting of a few, almost fully developed cells. The cells which are approximately of the same development and already have a long peduncular basal part, are linked at their basal ends. This is shown in photomicrograph 3, Table 1. The cell-ends meet in small gallert-nodules. It may be supposed that this gallert-matter is secreted by the peaks of the peduncular parts jointly and correspond to the gallert-matter which, in the case of other taxons, *e. g.* at the development of the *Synura uvella* EHR. colony, lengthen into thin gallert-threads and cent-

Table 1



1



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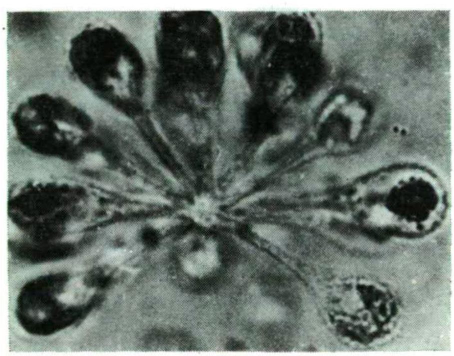

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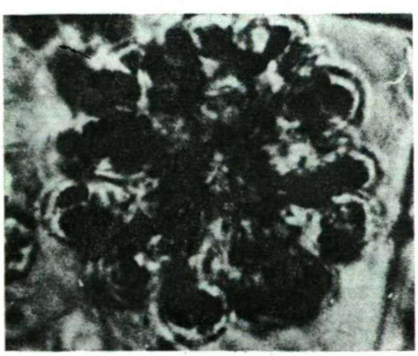

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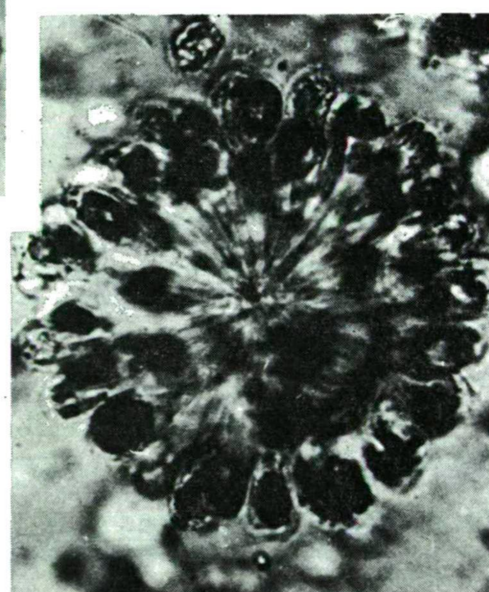

5

1. Gallert-membraned colony, with a solid surface layer. — 640:1
2. Release of a zoospore-cell from a dense colony without gallert-layer. — 640:1
3. Loose colony with cells having peduncularly elongated basal parts. — 640:1
4. Smaller colony with cells having still a short basal part. — 640:1
5. Larger colony consisting of fully developed cells, with a visible readial structure. — 640:1.

rally fasten together a number of cells. It could be observed in some cases in the cultured bioseston that the peduncular, basal cellular processes were embedded in larger gallert-nodes in such a way that almost the knot-like apical ends of the cells protruded from the gallert-mass. By this reason, it is not impossible that the *Synura*-cells secrete the gallert-matter mostly at the apical part of the peduncular basal part.

2. Formation of undeveloped cell-groups, having no basal peduncular part yet. This second way of colony-formation was the most frequent. This case is shown by photomicrograph 4, Table I. The apical parts of cells are already almost fully developed, their basal, peduncular part is, however, still very short or is nearly fully missing. The scales of the cell-membrane are also showing the picture of development. This initial state may develop both from a single zoospore-cell and from zoospore-masses, resp. from some undeveloped cell-masses which were formed of pieces of the colonies demonstrated in photomicrograph 2.

It is essential that both type 1 and type 2 of the development may later develop into colonies of dense, compact cell substance, consisting of fully developed cells of large volume. This state is demonstrated in photomicrograph 5, Table I. In this, the radial arrangement of cells is obvious, mainly owing to the elongation the peduncular basal part. In these, the number of cells may considerably exceed 100 and their diameter can reach 110—120 µm, as well.

It is worth mentioning from ecological point of view that the colonies of massive cell-substance were more frequent in the places of water surface where no shadow cast by the trees of the gallery-forest. The loose colonies occur rather under the surface or in the shaded surface in higher numbers (*e. g.*, photomicrograph 3).

* * *

The colonies of *Synura uvella* EHR. n. var. *tiszaensis* KISS I. have a diameter not longer than 120 µm. In their well-developed cells, there can be distinguished an ovoid apical part, and after its sudden narrowing a longer, peduncular basal part. The well-developed cells of the colony are 45—55 µm long and, in their apical part, 12—16 µm broad. The basal part is always longer. The scales of the cell-membrane are roundish or slightly elongated with a short spine. In the ontogeny of the species the gallert-membrane phase developing with the solid surface layer is striking.

Diagnosis

Synura uvella EHR. n. var. *tiszaensis* KISS I. — Colonia perfecta formam globosam habet, maxima diametiens eius est 120 µm. In cellis perfectis coloniae apicalis pars ovo similis et basalis pars petiolo similis oblongaque distingui possunt. Cellae 45—55 µm longae et in parte apicali 12—16 µm latae sunt. Longitudo partis basalis est semper maior. Squamae tegimenti cellarum sunt rotundae aut paullulum oblongae, et 2—4 µm longae sunt, latitudo earum paullo minor est. Aculei squamarum sunt curti. Proprietas conspicua ontogenesis coloniae est stadium in quo gallert-tegimentum existit. Summarum stratum gallert-tegimenti solidum est.

References

BOURELLY, P. (1957): Recherches sur les Chrysophycées. — Rev. Agol. Mém. Hors-Série *1*, 1—412.

BRADLEY, D. E. (1964): A study of the *Mallomonas*, *Synura* and *Chrysosphaerella* of Northern Iceland. — J. gen. Microbiol. *37*, 321—333.

FOTT, B. (1952): Mikroflora oravskykh raselin. Mikroflora oravskykh torfyanikov. Mikroflora der Orava-Moore. — Preslia *24*, 189—209.
FOTT, B. & LUDVIK, J. (1957): Die submikroskopische Struktur der Kieselschuppen bei *Synura* und ihre Bedeutung für die Taxonomie der Gattung. — Preslia *29*, 5—16.
HARRIS, K. & BRADLEY, D. E. (1958): Some unusual Chrysophyceae studied in the electron microscope. — J. gen. Microbiol. *18*, 71—83.
HUBER-PESTALOZZI, G. (1941): Das Phytoplankton des Süßwassers. Teil 2, 1. Chrysophyceen. Farblose Flagellaten. Heterokonten. — In Thienemann, A.: Die Binnengewässer, Bd. *16*, 1—366.
KORSHIKOV, A. A. (1929): Studies on the Chrysomonads I. — Arch. f. Protistenk. *67*, 253—290.
KORSHIKOV, A. A. (1942): On some new or little known flagellates. — Arch. f. Protistenk. *95*, 22—44.
KRISTIANSEN, J. (1964): Flagellates from Finnish Lappland. — Bot. Tidsskr. *59*, 315—333.
KRISTIANSEN, J. (1969): *Chrysosphaerella multispina* BRADLEY and some other remarkable Chrysophyceae from Lake Straken, Aneboda, Sweden. — Österr. Bot. Z. *116*, 70—84.
KRISTIANEN, J. & MATHIESEN, H. (1964): Phytoplankton of the Tystrup-Ravalse lakes, primary production and standing crop. — Oikos *15*, 1—43.
MACK, B. (1951): Morphologische und entwicklungsgeschichtliche Untersuchungen an Chrysophyceen. — Österr. Botan. Zeitschrift *98*, 249—279.
PANKOW, H. (1963): Bemerkung zur Ökologie von *Synura uvella* E. — Österr. Bot. Zeitschrift *110*, 410—416.
PÉTERFI, I. S. (1965): Observations of *Synura* EHRENB. in Rumania with special attention to *Synura splendida* KORSH. — Rev. Algol. 1965, 52—55.
PETERSEN, BOYE, J. & HANSEN, J. B. (1956): On the scales of some *Synura* species. Biol. Med. Dan. Vid. Selsk. *23*, 1—27.
PETERSEN, BOYE, J. & HANSEN, J. B. (1956): On the scales of some *Synura* species II. Biol. Medd. Dan. Vid. Selsk, *23*, 1—13.
TAKAHASHI, E. (1959): Studies on genera *Mallomonas*, *Synura* and other plankton in fresh-water with the electron microscope I. — Bull. Yamagata Univ. (Agricult. Sci.) *3*, 117—151.
TAKAHASHI, E. (1961): Studies on genera *Mallomonas*, *Synura* and other plankton in fresh-water with the electron microscope III. — Bull. Yamagata Univ. (Agricult. Sci.) *3*, 33—51.
TAKAHASHI, E. (1964): Studies on genera Mallomonas, *Synura* and other plankton in fresh-water with the electron microscope. — Bull. Yamagata Univ. (Agricult. Sci.) *4*, 137—145.

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BEITRÄGE ZUR KENNTNIS ÜBER DAS VORKOMMEN DER SCENEDESMUS-ARTEN IN UNGARN. III. DATEN AUS SÜDUNGARN

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Auszug

In der Abhandlung werden aus verschiedenen Gewässern Südungarns (Donau, Donauseitenarm, Kanäle, kleinere Seen, bzw. Teiche) zusammen über 36 *Scenedesmus*-Taxa solche Beiträge geliefert, die aus irgendeinem Grund besondere Aufmerksamkeit verdienen.

Unter den besprochenen Taxa werden fünf erst hier beschrieben. Diese sind: *Scenedesmus apiculatus* f. *disciformis*, nova forma; *S. armatus* var. *compactus*, nova var.; *S. denticulatus* f. *propriodenticulatus*, nova forma; *S. protuberans* var. *procerus*, nova var.; *S. soli* var. *exornatus*, nova var.

Auch über selten vorkommende Scenedesmus-Taxa liefern wir einige, die völligere morphologische Umgrenzung der betreffenden Taxa bezweckende Angaben *(S. acuminatus* f. *globosus, S. anomalus, S. grahneisii, S. granulatus* f. *disciformis, S. regularis)*.

Es werden auch Angaben über "zwillingswertige" Zellen enthaltende Coenobien, unregelmässige Zellenzahlen *(S. acutus, S. denticulatus, S. quadricauda)*, sowie über die monodesmoide, Chodatella-artige Erscheinungsform des *S. opoliensis* und über einige ausserordentliche Bestachelungen *(S. quadricauda, S. quadricauda* var. *setosus, S. spinosus)* mitgeteilt.

Die übrigen Angaben mögen zur Verbreitung der betreffenden Organismen in Ungarn, bzw. zur Ökologie dieser Ergänzungen beitragen.

Einleitung

Die Grünalgengattung *Scenedesmus* (Chlorococcales) ist morphologisch ausserordentlich reich gegliedert. Die Aufmerksamkeit der Forscher wurde durch die sowohl unter den natürlichen Verhältnissen bemerkbare als auch unter den speziellen Zuchtverhältnissen auslösbare Plastizität seiner Taxa besonders seit der Jahrhundertwende in erhöhtem Masse auf diese Gattung gerichtet. Über die Gattung haben bisher G. M. SMITH (1916), CHODAT (1926), UHERKOVICH (1966) und PHILIPOSE Studien monograpischen Anspruchs zusammengestellt.

Als es sich zeigte, dass gewisse Arten der Gattung ausgezeichnete Objekte zur Klärung grundlegender pflanzenphysiologischer Gesetzmässigkeiten sind und als es dann bekannt wurde, dass einige *Scenedesmus*-Arten in der Massenzüchtung ausgezeichnet verwendet werden können, haben auch diese Aspekte in der Forschung der Gattung einen besonderen Akzent erhalten. Es seien von den diesbezüglichen zahlreichen, mit gewissen Schulen ferbundenen Forschungen als charakteristische Beispiele die Ergebnisse von RODHE und Mitarbeitern (RODHE 1948 usw.), von FELFÖLDY und Mitarbeitern (FELFÖLDY 1960 usw.), die der "Schule" in Třeboň (NEČAS, KOMÁREK und Mitarbeiter) erwähnt, obwohl die Aufzählung noch lange fortgesetzt werden könnte.

Seit den 60-er Jahren begann man die feinsten, nur mit dem Elektronenmikroskop beobachtbaren Elemente der *Scenedesmus*-Zellen zu studieren (z. B. BISALPUTRA und Mitarbeiter 1963, 1964, usw., KOMÁREK und Mitarbeiter 1971, 1972 HINDÁK und KLASOVA 1974, usw.).

Es ist seit 15 Jahren auch im Gange, die Induzierung der unter den Versuchsverhältnissen entstehenden eigenartigen Vermehrungsformen, bzw. Formveränderungen innerhalb der Gattung zu studieren (TRAINOR und Mitarbeiter 1963, 1966; 1965, 1971, 1976; UHERKOVICH—FELFÖLDY—KALKÓ 1962, FELFÖLDY—UHERKOVICH 1965, NEČAS 1976 a, 1976 b; HINDÁK 1974, usw.).

Man hat den Gesamteindruck, dass in der Erforschung der Gattung in den letzten zwei Jahrzehnten die Untersuchung des Freilandmaterials, der in den natürlichen Wasserproben befindlichen Organismen nicht mit der Intensität fortgesetzt wurde, die erwünscht gewesen wäre, um eben die Ökologie der Gattung, aber teilweise auch ihren morphologischen Reichtum eingehender aufzudecken. Eine Ausnahme bilden hier fast nur die Werke der ungarischen und zum Teil der sowjetischen Forscher, die über die reichen *Scenedesmus*-Vorkommnisse von verschiedenen Oberflächengewässern detailreiche Mitteilungen veröffentlicht haben (HORTOBÁGYI 1967, 1969 a, 1969 b, 1971 a, 1971 b, 1973, 1975, 1976 a, 1976 b, UHERKOVICH 1968, 1970, 1971 a, 1971 b, 1973, 1974, 1976 a, 1976 b, UHERKOVICH—G. W. SCHMIDT 1974, UHERKOVICH—A. SCHMIDT—VÖRÖS 1975, MASJUK 1958, usw.).

Es wird, meines Erachtens, durch die richtigeren inneren Verhältnisse der Erforschung der Gattung erfordert, dass ausser den instrumental-experimentellen Forschungen auch die Erforschung der in den natürlichen Wasserproben gefundenen *Scenedesmus*-Taxa, undzwar mit den limnologischen Forschungen unmittelbar verbunden und auf den wasserchemischen und ökologischen Angaben basierend, mit gewisser Intensität forgesetzt werden soll. Im Zeichen diesen Gedankens veröffentliche ich meine gegenwärtige Abhandlung, die als Fortsetzung einer früher begonnenen Serie (UHERKOVICH 1956, 1960) diesmal aus den südungarischen Oberflächengewässern *Scenedesmus*-Angaben bringt.

Ursprung des untersuchten Materials

Ein bedeutender Teil der in dieser Abhandlung veröffentlichten Angaben rührt von den Untersuchungen her, die ich an südungarischen Gewässern zusammen mit A. SCHMIDT (Laboratorium für Wassergüte, Direktion für Wasserwesen, Baja) durchgeführt habe.

Die anderen Angaben rühren von meinen eigenen Untersuchungen her. Ich will hier bemerken, dass meine auf einigen Gewässern von Süd-Ungarn und Transdanubien ausgeführten Untersuchungen noch weitere *Scenedesmus*-Vorkommnisse in bedeutender Anzahl klargesetellt haben, worüber ich mich in anderen Publikationen ausbreite (UHERKOVICH 1974, 1976 und noch andere, im Druck befindliche Abhandlungen).

In der gegenwärtigen Abhandlung werden nur jene *Scenedesmus*-Angaben veröffentlicht, die aus irgendeinem Grund eine grössere Aufmerksamkeit verdienen, eine besondere Besprechung beanspruchen und in meinen oben erwähnten Publikationen nicht vorkommen.

Die einzelnen Oberflächengewässer, aus denen die *Scenedesmus*-Angaben der gegenwärtigen Abhandlung stammen, waren die folgenden:

1. Die Donau zwischen Dunaföldvár und Mohács. — Die Donau hat hier Unterlaufcharakter, ein waldiges Überschwemmungsgebiet und wird meistens von

Neben- bzw. toten Armen begleitet. Ihr Wasser ist von Ca—Mg—HCO_3-Ionentyp, gelöster Stoffinhalt ist am meisten um 300 mg/l. Es ist mesotroph, periodisch aber wird es eutroph. Der a-Chlorophyllinhalt ist im Winter 10 mg/m^3, im Sommer 50—100 mg/m^3.

2. Die Kamarás—Donau (Sugovica) bei Baja. — Sie ist ein linksufriger Nebenarm der Donau, der mit der Donau in seiner völligen Flussbettbreite verbunden ist. Seine Wasserqualität — da er ein Sackarm ist — wird vor allem durch die Pegelschwankungen der Donau bestimmt. Im Falle eines lange andauernden unveränderten Wasserstandes mögen sich dort auch einige von der Donau wesentlich verschiedene aktuelle limnologische Gepräge entfalten.

3. Der Nährkanal des Franz—Kanals. — Er verbindet die Kamarás—Donau bei Baja durch eine praktisch immer geschlossene Schleuse mit dem Grossen—Kanal (Franz—Kanal) in Jugoslawien. Er ist eher von Stillwassercharakter, manchmal mit einer ganz kleinen Strömung. Sein Wasser ist von Ca—Mg—HCO_3-Ionentyp, am meisten mit 300 mg/l, manchmal mit 550—600 mg/l gelösten Stoffen.

4. Hauptkanal bei Karapancsa. — Er sammelt die Gewässer der linksufrigen Donauinsel Margitta (Insel bei Mohács) zusammen. Er ist teilweise ein ehemaliger Donaualtwasser, teilweise ein künstlicher Kanal. Er ist fast völlig frei vom anthropogenen Einfluss. Sein Wasser ist annähernd derselben Zusammensetzung und Qualität wie das des Nährkanals des Franzkanals.

5. Kígyós—Bach. — Er ist ein sich südlich von Baja entlang der ungarisch—jugoslawischen Grenze schlängelnder, teilweise kanalisierter Wasserlauf. Er steht unter einem starken anthropogenen Einfluss, durchfliesst mehrere Siedlungen. Sein Wasser ist von Ca—Mg—HCO_3-Ionentyp, mit 500—1000 mg/l gelöstem Stoffinhalt, sein Ammoniuminhalt ist 1,5—2 mg/l.

6. Donautal—Kanal (DVCs). — Er ist ein südlich von Budapest an der linken Terasse des Flusses künstlich angelegter Kanal, der im grossen und ganzen parallel mit der Donau fliesst und oberhalb der Bajaer Eisenbrücke darin mündet. Die Qualität seines Wassers ist ziemlich veränderlich. Das Wasser enthält am meisten 350—750 mg/l gelösten Stoffe.

7. Csorna—Foktő—Kanal. — Er ist ein flutverringernder Kanal des Donautal—Kanals, dessen Wasserüberschuss bei Foktő in die Donau hinübergehoben wird. Er wird vom teilweise gereinigten Abwasser der Stadt Kalocsa belastet.

8. Hauptkanal I. von Sárköz. — Er ist ein vom Vorigen bei Kalocsa abzweigender Kanal, mit identischen wasserchemischen und wasserqualitätzeignenden Indexzahlen.

9. Sió-Mündung. — Der Fluss Sió ist ein durch die Kapos- und Nádor-Kanäle stark belasteter Wasserlauf. Sein gelöster Stoffinhalt ist meistens zwischen 450—600 mg/l, mit einem zwischen 0,2—6,0 mg/l schwankenden Ammoniuminhalt und mit Nitrat- und Phenolschmutzstoffen.

10. Szelider-See. — Er ist ein ehemaliger, auf natürlicher Weise abgeschnürter Donauarm, der den Bodenverhältnissen zufolge ein Stillwasser bedeutenden Salzinhalts wurde. Sein Wasser ist von Na—HCO_3—Cl-Ionentyp, zwischen den Jahren 1937—1955 mit einem gelösten Stoffinhalt von 1560—4110 mg/l. Seine gelösten Stoffe haben sich wegen der aus dem Soroksárer Donauarm vor einigen Jahren verwirklichten Wasserzuführung bedeutend vermindert, so konnten im Jahr 1976 die Werte zwischen 750—1025 mg/l festgestellt werden. In der Vergangenheit war dieses Wasser wiederholt der Gegenstand hydrobiologischer Forschungen und wird in der Gegenwart ein mehr und mehr wichtiges Erholungswasser (Donászy red. 1959, Schmidt 1975).

11. Vadkerter-See. — Ein seichter, aber ständiger Natriumkarbonatsee im Donau-Theiss-Zwischenstromgebiet nördlich von der Gemeine Soltvadkert, mit einer 74 ha grossen Oberfläche. Zwischen 1966—1975 war sein gelöster Stoffinhalt 660—1000 mg/l, die p_H-Werte waren am meisten zwischen 8,8—9,2. Vorherig war sein gelöster Stoffinhalt bedeutend höher (selbst mit Werten über 6000 mg/l). Es erfolgte unter dem Einfluss der ionischen Zusammensetzung und der kelineren Konzentration des dahingeleiteten Donau-Wassers eine „Aussüssung" und eine in der Richtung des Mg verschobene Ionentypenveränderung im See während der letzten zehn Jahren (vgl. SCHMIDT 1977).

Die untersuchten Scenedesmus-Taxa

In Hinsicht der Taxonomie der Gattung befolgen wir im allgemeinen die Prinzipien unserer älteren Monographie (UHERKOVICH 1966). Es wird besonders besprochen, wo wir davon abweichen.

Am Ende der Besprechung der einzelnen Taxa, verbunden mit den Vorkommnisdaten, verweisen wir auf unser Abbildungsmaterial.

1. *Scenedesmus acuminatus* (LAGERH.) CHOD. — 4-zellige Coenobien, alternierend aufgebaut aus spindelförmigen Zellen von Grössen 23—26×4,5—5,5 µm. Auch der typische Vertreter der Art wird aus unserem Material gebracht, um eine eindeutige Vergleichung zwischen den auf derselben Tafel mitgeteilten Abbildungen der Art und ihrer Varietäten zu ermöglichen (s. unser Tafel IV). — Tafel IV. Abb. 50=Kígyós-Bach, 7.6. 1971.

2. *S. acuminatus* var. *acuminatus* f. *globosus* HORTOB. et NÉMETH — 4-zellige Coenobien von 18,5—32,5×4—5,5 µm grossen, sich allmählich verjüngenden Zellen. An beiden Enden der Zellen gibt es je einen kleinen kugelförmigen Knorren. Ein zeimlich seltener Organismus. Bei den „vollentwickelten" Coenobien unterscheiden wir sowohl bei der Art als auch bei deren Varietäten Formen, Morphotypen aus schlankeren und solche aus stämmigeren Zellen. Dies geht auch aus dem Vergleich beider hier gebrachten Beispiele (Tafel III, Abb. 36 und 47) hervor. — Tafel III, Abb. 36=Szelider-See, 15.10. 1973, Tafel III, Abb. 47=Donau bei Dunaföldvár, 27. 3. 1973.

3. *S. acuminatus* var. *acuminatus* f. *maximus* UHERKOV. — Die Coenobien von 56—60×51—54 µm Grösse sind 8-zellig, alternierend, zweireihig aufgebaut. Die Grösse der Aussenzellen ist 51—53×7,8—8,2 µm. — Tafel IV, Abb. 51=Bajaer Kamarás-Donau, 23. 10. 1971.

4. *S. acuminatus* var. *bernardii* (G. M. SMITH) DEDUSS. — Stark alternierende lockere Coenobien spindelförmiger Zellen von 17—19×4—5,3 µm Zellgrössen. Die Zellen kommen nur mit dem 1/8—1/4 Teil ihrer Länge miteinander in Berührung und manchmal — wie auch auf unserer Abbildung — passen zwei Nachbarzellen auf unregelmässige Weise, nicht alternierend zusammen. — Tafel IV, Abb. 63= Donau bei Baja, 20. 7. 1972.

5. *S. acuminatus* var. *elongatus* G. M. SMITH — Die sich gleichmässig verjüngenden sichelförmigen Zellen von einer Spannweite von 33—36 µm fügen sich mit ihren mittleren Teilen unregelmässig zusammen. — Tafel IV, Abb. 52=Bajaer Kamarás-Donau, 23. 10. 1971.

6. *S. acutiformis* SCHRÖDER — 4-zellige Coenobien von 14,5—15,5×8—5,2 µm grossen Zellen. An den Flanken der breitspindelförmigen Zellen erstreckt sich je eine Oberflächenrippe ohne Unterbrechung, die an den Polen in einem kurzen, stumpfen

Zahn endet. Sein Vorkommen wird manchmal mit einem speziellen wasserchemischen Hintergrund verbunden. — Tafel II, Abb. 15=Vadkerter-See, 13. 6. 1973.

7. *S. acutus* MEYEN — Ausser den charakteristischen Vertretern der Art (z. B. Tafel III, Abb. 41) wurden in den von uns untersuchten Gewässern auch einige unregelmässig gestaltete Coenobien gefunden. Die Besprechung eines von diesen scheint nützlich zu sein: Es ist ein 18×35 μm grosses 7-zelliges Coenobium (Tafel II, Abb. 32), in dem die Gestaltung der einzelnen Zellen gewisse Verzerrungen im Vergleich zu den präponderanten Zellgestalt der Art aufweist. Die Präsenz einer umfangreicheren triangulären Zelle im Coenobium, offensichtlich von „Zwillingswert", ist besonders auffällig. — Tafel II, Abb. 32=Donau bei Baja, 9. 8. 1975, Tafel III. Abb. 41-Kígyós-Bach, 7. 6. 1971.

8. *S. acutus* var. *acutus* f. *alternans* HORTOB. — Diese Form weicht nicht nur mit der immer besser ausgeprägten Alternierung des Coenobiums, sondern auch mit ihren grösseren Zelldimensionen von der Art ab. Dafür vermag ich auch jetzt ein gutes Beispiel anzuführen nämlich, dass in derselben Wasserprobe (Kígyós-Bach, 7.6. 1971) die Zellgrössen des *S. acutus* (13,5—16,5×4—4,7 μm) von den Zellgrössen der mit ihnen zusammen befindlichen *S. acutus* f. *alternans* — Inviduen (18—23×5,5—6,5 μm) sehr bestimmt und ohne Übergänge abweichen. — Tafel III, Abb. 40=Kígyós-Bach, 7. 6. 1971).

9. *S. anomalus* (G. M. SMITH) TIFF. — 2 oder 4, manchmal (Tafel III, Abb. 42) 3-zellige Coenobien von schmalen, zyilndrischen Zellen mit runden Enden, die von der Mittelachse des Coenobiums sich bogenförmig hinausbeugen. Es gibt am Ende der lateralen Zellen des Coenobiums je einen dünnen Stachel schiefer Stellung und von einer 1/2—3/4 Zellenlänge. Unsere Beobachtungen, wonach aus je einer Mutterzelle vier „Scenedesmus-artig" gebildete Tochterzellen heraustreten können (z. B. Tafel III, Abb. 44), möge die Ausffassung, demgemäss, dieser Organismus nicht der *Scenedesmus*-Gattung, sondern der *Didymogenes*-Gattung zugehöre, mit Recht zurückweisen. — Tafel III, Abb. 38, Abb. 42 und Abb. 44=Donau bei Baja, 9. 8. 1975.

10. *S. apiculatus* (W. et G. S. WEST) CHOD. var. *apiculatus* f. *disciformis* UHERKOVICH, nova forma. — Eng geschlossene zweireihige 8-zellige Coenobien breiter spindelförmiger Zellen von 12,5—14×5,5—6,8 μm Grösse. Auf beiden Polen der Aussenzellen, ferner auf den herausragenden Polen der Innenzellen steht je ein stumpfer Zahn. Die Form unterscheidet sich von der Art durch das zweireihige, achtzellige Coenobium (Ikonotyp=Tafel IV, Abb. 58). — *S. apiculatus* unterscheidet sich von dem ihm morphologisch am nächsten stehenden *S. incrassatulus* BOHLIN dadurch, dass während bei der ersten Art auf dem Zellpol ein kleiner Zahn sitzt, bei der zweiten auf den Polen auf einer kurzen Strecke die ganze Zellwand dicker wurde. Es soll hier auch erwähnt werden, dass die Tendenz, die sich bei den stachellosen *Scenedesmus*-Arten in dem zweireihigen „disciform" Coenobiumaufbau allgemein gut manifestiert, auch hier ihre Bestätigung gefunden hat. — Tafel IV, Abb. 58=Karapancsaer-Hauptkanal, 7. 6. 1976.

Scenedesmus apiculatus (W. et G. S. WEST) CHOD. var. *apiculatus* f. *disciformis* UHERKOVICH, nova forma — Coenobia 8-cellularia, e cellulis distichis, late fusoideis, 12,5—14×5,5—6,8 μm magnis, arcte cohaerentibus formata. Poli ambo cellularum extimarum et poli exserti cellularum intermediarum dentibus singulis obtusis. Forma nostra nova a specie typica coenobiis e cellulis 8, distichis formatis distincta. (Iconotypus=fig. nostr. IV. 58.)

11. *S. armatus* CHOD. forma — 16,5—18×7—7,8 μm grosse Zellen bilden eng schliessende 8-zellige Coenobien. Auf den inneren Zellen eine aus einem heraus-

Tafel I

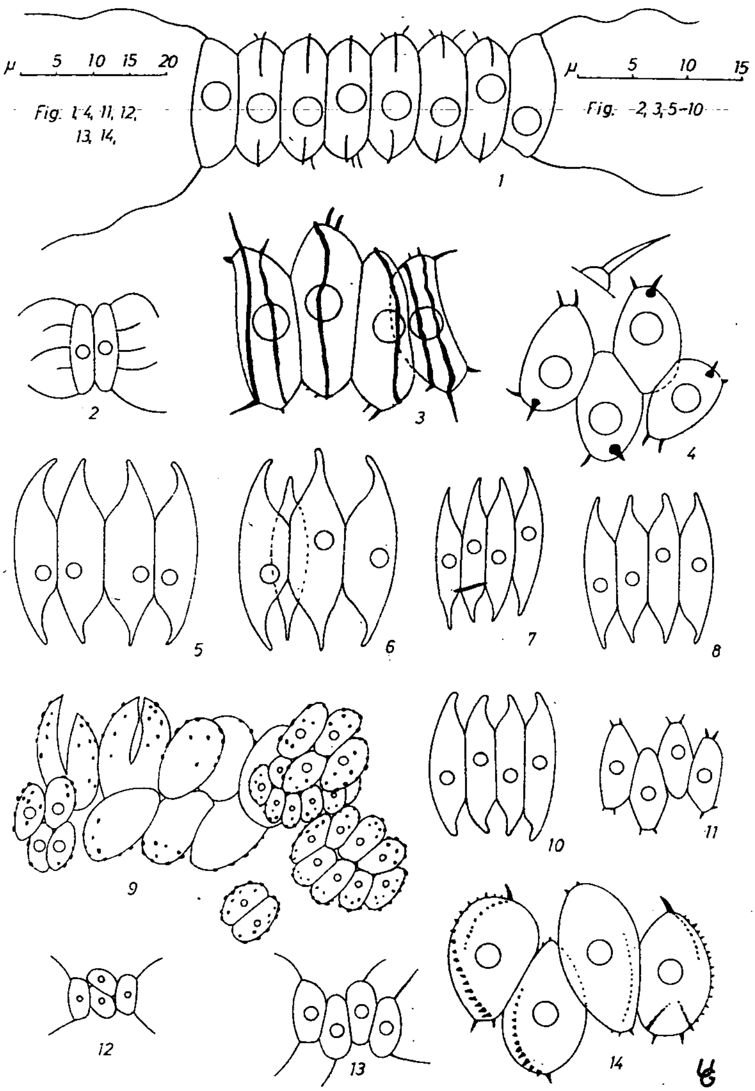

Abb. 1—14.1. *Scenedesmus armatus* CHOD forma, 2. *S. spinosus* CHOD., 3. *Scenedesmus* sp. 2. 4. *S. denticulatus* LAGERH. var. *denticulatus* f. *propriodenticulatus* UHERK., nova forma, 5—8. *S. regularis* SWIRENKO, 9. *S. granulatus* W. et G. S. WEST var. *granulatus* f. *disciformis* HORTOB., 10. *S. regularis* SWIRENKO, 11. *S. denticulatus* LAGERH., 12. *S. intermedius* CHOD. (forma?), 13. *S. intermedius* CHOD. var. *balatonicus* HORTOB., 14. *S. soli* HORTOB. var. *exornatus* UHERK., nova var.

stehenden Zahn der Pole ausgehende Oberflächenrippe von 1/5—1/4 Zellenlänge. Auf den Polen der Inneren Zellen sitzen manchmal auch noch ein oder mehrere längere Zähne, bzw. kurze Stacheln. Auf beiden Polen der äusseren Zellen gibt es einen 1 1/2—1 1/3 zellenlangen welligen Stachel, der zur Längsachse der Zelle beinahe einen rechten Winkel einschliessend steht. Auf den äusseren Zellen gibt es ausser den beiden Stacheln keine weitere Ornamentierung. Von der Art als dem Typ, weicht dieser Organismus mit der Grösse und form der Stacheln, mit der Bezahnung der inneren Zellen gleichermassen ab. Nachdem mir zu seiner eingehenderen morphologischen Abgrenzung kein genügendes Beobachtungsmaterial vorlag, sehe ich von einer formellen taxonomischen Absonderung dieser Alge vorläufig ab. — Tafel I, Abb. 1 =Donau bei Baja, 20. 7. 1976.

12. *S. armatus* CHOD. var. *compactus* UHERKOVICH, nova var. — 4-zellige und 8-zellige Coenobien von 10–12×5,4–6,2 µm grossen, breit ellipsoiden oder ovoiden Zellen. In der Mitte des Coenobiums kommen die Zellen miteinander schief in Berührung. Deswegen besteht das Coenobium aus zweien, voneinander ein wenig verschobenen Hälften. Auf den Polen der äusseren Zellen sitzt je ein 1/2–2/3 zellenlanger, ein wenig gebogener Stachel. Von den Polen der Zellen aus läuft eine aus einem kleinen Zahn entspringende und sich an die Seite der Zellen anschmiegende, partielle Oberflächenrippe. Von der Art als dem Typ unterscheidet sich die Varietät durch die immer stämmigeren Zellform, die kürzeren Stacheln und die Eigenheiten des Coenobiumaufbaus. (Ikonotyp=Tafel II. Abb. 28) — Die verhältnismässig stämmige Zellform und das mässige Alternieren im Coenobiumaufbau kommen auch bei der Stammform des *S. armatus* vor (vgl. UHERKOVICH 1966). Die hier beschriebene Varietät aber unterscheidet sich noch überdies von der Stammform darin, dass die Stacheln immer kurz sind und das Coenobium sozusagen aus zwei symmetrischen, verschobenen Hälften aufgebaut wird. — Tafel II, Abb. 16= Szelider-See, 26. 3. 1973, Tafel II, Abb. 28=Kígyós-Bach, 7. 6. 1971.

Scenedesmus armatus CHOD. var. *compactus* UHERKOVICH, nova var. — Coenobia 4 —, vel 8-cellularia, e cellulis late ellipsoideis, vel ovoideis, 10–12×5,4–6,2 µm magnis efformata. Coenobia propter cellulas in medio coenobii oblique sese conjunctas e dimidiis duobus inter parum inclinatis, 1/3–2/3 parte longitudinis cellulae aequantibus. In lateribus cellularum costis singulis partialibus, a denticulo parvo polari exeuntibus. A specie typica statura semper compacta, spinis brevioribus constructioneque coenobiorum distinca. (Iconotypus=fig. nostr. II. 28.)

13. *S. baculiformis* CHOD. — 11,5–12,5×5 µm grosse Zellen bilden zweireihige 8-zellige Coenobien. Die Zellen enden in einem abgerundeten Pol. Die äusseren Zellen sind asymmetrisch, nach aussen mit einer geraden Zellwand begrenzt. Unser Organismus stimmt mit der von CHODAT abgegrenzten Art in der Zellform und in den Grundzügen des Coenobienaufbaus dem Wesen nach überein, aber er unterscheidet sich auch davon in dem 8-zelligen Coenobienaufbau und deshalb in der mehr zusammengepressten, weniger gewölbten Zellform. (Es handelt sich hier vielleicht um eine neue Form der Art.) — Tafel IV, Abb. 64=Kígyós-Bach, 12. 6. 1972.

14. *S. carinatus* (LEMM.) CHOD. — Geradlinige 4-zellige Coenobien von 15–16×4,8–5,5 µm grossen spindelförmigen Zellen. Auf den äusseren Zellen ist eine zellenlange gebogene Cauda. Von den Polen auf die Seite der Zellen läuft eine unvollkommene Oberflächenrippe, die auf den Polen einen kleinen Zahn bildet. Es gibt überdies auf den inneren Zellen beiderseits bei diesem Zahn je einen weiteren Zahn, der sich in einer sehr kurzen Oberflächenrippe fortsetzt. — Tafel IV, Abb. 52= Bajaer Kamarás-Donau, 23. 10. 1971.

15. *S. denticulatus* LAGERH. — Weniger oder stärker alternierende 4-zellige Coenobien von 15×5–7 µm grossen Zellen. Es gibt auf beiden Polen der lateralen Zellen und auf dem herausragenden Pole der intermediären Zellen und auf dem herausragenden Pole der intermediären Zellen je zwei kurze Zähne. Wir haben auch ein dreizelliges Coenobium beobachtet, mit einer umfangreichen, offenbar

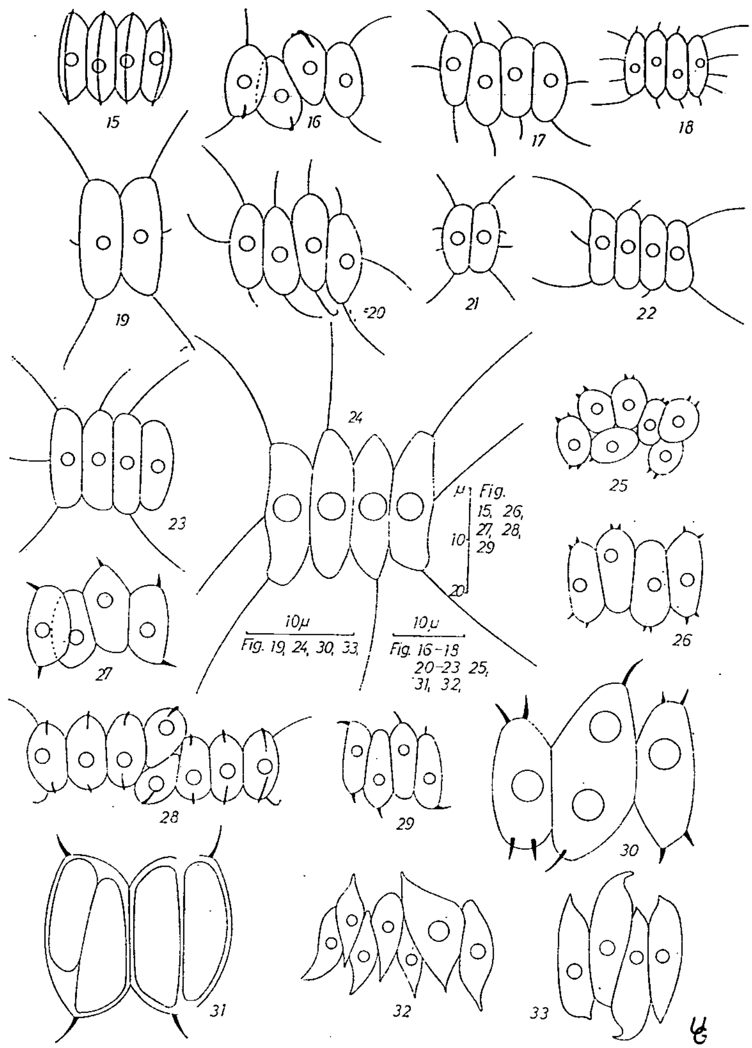

Abb. 15—33. 15. *Scenedesmus acutiformis* SCHRÖDER, 16. *S. armatus* var. *compactus* UHERK Nova var., 17—18. *S. spinosus*CHOD. var. *bicaudatus* HORTOB., 19. *S. spinosus*CHOD., 20. *S. spinosus* nHOD. var. *bicaudatus* HORTOB., 21—23. *S. spinosus* CHOD., 24. *S. spinosus* CHOD. var. *danubials* CORTOB., 25. *S. denticulatus* LAGERH. var. *fenestratus* (TEILING)UHERK., 26. *S. denticulatus* LAGERH., 27. *S. dispar* BRÉB., 28. *S. armatus* CHOD. var. *compactus* UHERK. nova var., 29. *S. dispar* BRÉB. 30. *S. denticulatus*LAGERH., 31. S. *dispar* BRÉB., 32. *S. acutus* MEYEN, 33. *Scenedesmus* sp.

„zwillingswertigen" Mittelzelle mit zwei Pyrenoiden (Tafel II, Abb. 30). – Tafel I, Abb. 11=Bajaer Kamarás-Donau, 31. 8. 1971, Tafel II, Abb. 26=Kígyós-Bach, 7. 6. 1971, Tafel II, Abb. 30=Sárközer I. Hauptkanal, 19. 7. 1976.

16. *S. denticulatus* LAGERH. var. *denticulatus* f. *propriodenticulatus* UHERKOVICH, nova forma — Stark alternierende 4-zellige Coenobien von 13,5–15,5×9–11 μm grossen stämmigen eiförmigen Zellen. Im Coenobium kommen die Zellen miteinander

auf einer Strecke von ungefähr 1/3–2/5 Zellenlänge in Berührung. Es gibt auf beiden Enden der lateralen Zellen und auf dem herausgragenden Ende der Mittelzellen je zwei kürzere Zähne. Ein Teil dieser Zähne hat eine breite Basis. Dieses letztere Merkmal ist für die Form charakteristisch (Ikonotyp=Tafel I. Abb. 4). — Tafel I, Abb. 4=Bajaer Kamarás-Donau, 21. 7. 1976.

Scenedesmus denticulatus var. *denticulatus* f. *propriodenticulatus* UHERKOVICH, nova forma — Coenobia 4-cellularia, e cellulis 13,5–15,5×9–11 µm magnis, late ovoideis, valde alternantibus, parte 1/3–1/4 longitudinis sese attingentibus formata. Poli ambo cellularum extimarum et poli exserti cellularum mediarum dentibus binis brevioribus. Nonnulli dentim parte basali dilatati. A specie typica parte basali dilatata dentium nonnullorum distincta. (Iconotypus=fig. nostr. I. 4.)

17. *S. denticulatus* var. *fenestratus* (TEILING) UHERKOV. — Ein wenig ungeordnete zweireihige Coenobien von 4,8–5,6×7,2–7,8 µm grossen stämmigen ellipsoiden oder ovoiden Zellen. Es gibt zwischen den Zellen kleinere Zwischenräume und auf den freistehenden Polen der Zellen ein oder zwei stumfe Zähne. Ein selten beobachteter Organismus. — Tafel II, Abb. 25=Kígyós-Bach, 7. 6. 1971.

18. *S. dispar* BRÉB. — 4-zellige, sehr selten 2-zellige Coenobien von 15–20×5–12 µm grossen Zellen, teils von typischer morphologischer Entfaltung (Tafel II, Abb. 27, 29). Es kam aber auch ein solches Coenobium vor, das 2-zellig war und n der Weiterbildung des Tochtercoenobiums wahrscheinlich diesen Morphotyp vertritt (Tafel II, Abb. 31). Tafel II, Abb. 27, 29=Kígyós-Bach, 7. 6. 1971, Tafel II, Abb. 31=Sió-Mündung, 14. 10. 1975.

19. *S. ellipsoideus* CHOD. — In der Richtung der Querachse ausdrücklich gekrümmte, 8-zellige Coenobien von miteinander eng zusammengefügten, 9–11×5–6 µm grossen Zellen. Das Vorkommen ist hauptsächlich wegen des gekrümmten Coenobiums baechtungswert. — Tafel III, Abb. 49=Bajaer Kamarás-Donau, 23. 10. 1971.

20. *S. grahneisii* (HEYNIG) FOTT — Aus 7,5–8,2×2,8–3,1 µm grossen Zellen bestehende 2-zellige Coenobien. Auf den Flanken der Zellen ist eine vom Pol ausgehende und in der Nähe der Konturlinie verlaufende, 06,–0,7 µm breite, flache, unregelmässige Oberflächenrippe von ungefähr 1/3 Zellenlänge. Vom ersten Vorkommen dieser seltenen Alge in Ungarn haben wir eine Mitteilung bereits veröffentlicht (SCHMIDT—UHERKOVICH 1976). Das hier veröffentliche Vorkommen ist nicht nur eine weitere Vorkommnisangabe, sondern es weist gleichzeitig auch darauf hin, dass diese Alge selbt in der Gestalt so schlanker Zellen erscheinen könne. — Tafel III, Abb. 37=Franz-Nähraknal, 6. 5. 1976.

21. *S. granulatus* W. et G. S. WEST var. *granulatus* f. *disciformis* HORTOB. — Zweireihige 4-zellige oder 8-zellige Coenobien von 6,2–9,8×3,8–6,5 µm grossen Zellen granulierter Oberfläche, die sich eng zueinander fügen. Es scheint mir nützlich, zuerst jene Beobachtung mitzuteilen, dass von demselben Muttercoenobium selbst 2-4-8-zellige Tochtercoenobien zustande kommen können (Tafel I, Abb. 9). Der „disciforme" Coenobienaufbau in sich selbst kann keineswegs als ein spezifischer Artcharakter angesehen werden, so ist die Absonderung des Taxon als Art (=*S. verrucosus* ROLL) nicht berechtigt. Ügrigens ist es durch die hier veröffentlichte Beobachtung bestätigt worden, dass bei diesem Taxon der „disciforme" Coenobienaufbau nur mit Tendenzcharakter besteht. — Tafel I, Abb. 9=Karapancsaer Hauptkanal, 7. 6. 1976, Tafel III, Abb. 35=Kígyós-Bach 7. 6. 1971.

22. *S. intermedius* CHOD (forma?) — In den 4-zelligen Coenobien sind die stacheligen lateralen Zellen etwa 4×5,5 µm gross, die zwei inneren Zellen des Coenobiums fügen sich schief zueinander. Sie sind ovoider Form und 3,5–3,8×

Tafel III

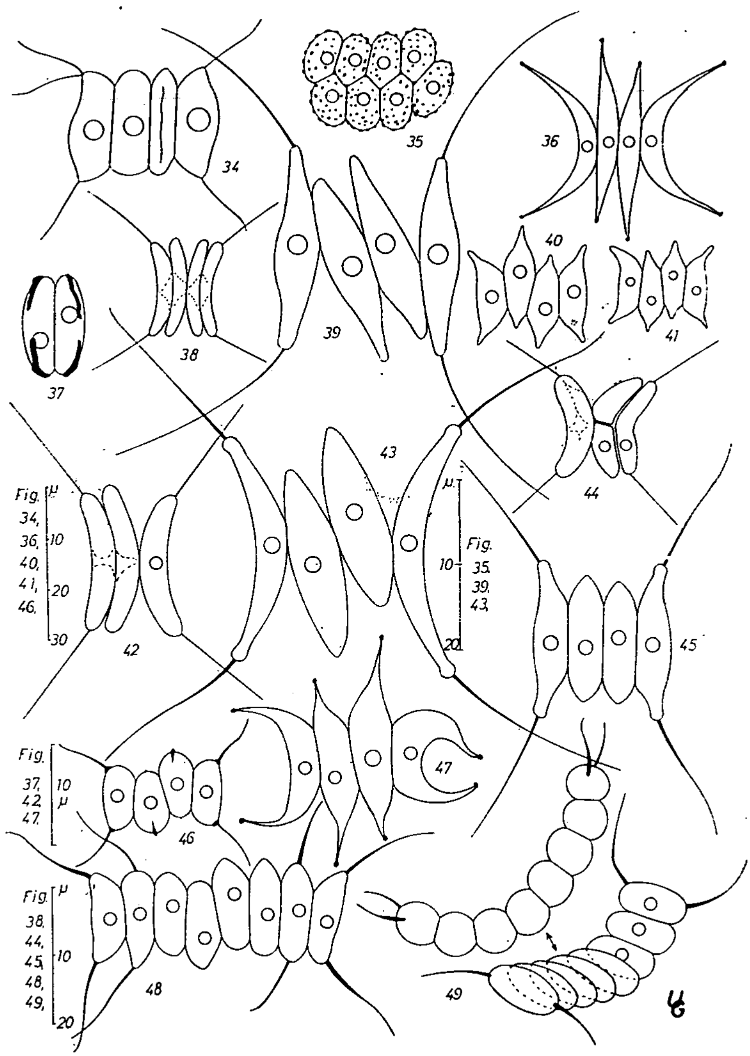

Abb. 34—49. 34. *Scenedemus quadricauda* (Turp.) Bréb., 35. *S. granulatus* W. et G. S. West var. *granulatus* f. *disciformis* Hortob., 36. *S. acuminatus* (Lagerh.) Chod. var. *acuminatus* f. *globosus* Hortob. et Németh, 37. *S. grahneisii* (Heynig) Fott, 38. *S. anomalus* (G. M. Smith) Tiff., 39. *S. protuberans* Fritssch var. *procerus* Uherk., nova var., 40. *S. acutus* Meyen var. *acutus* f. *laternans* Hortob., 41. *S. acutus* Meyen, 42. *S. anomalus* (G. M. Smith) Tiff., 43. *S. protuberans* Fritsch var. *procerus* Uherk., nova var., 44. *S. anomalus* (G. M. Smith) Tiff., 45. *S. protuberans* Fritsch, 46. *S. sooi* Hortob., 47. *S. acuminatus* (Lagerh.) Chod. var. *acuminatus* f. *globosus* Hortob. et Németh, 48. *S. quadricauda* (Turp.) Bréb. var. *setosus* Kirchn., 49. *S. ellipsoideus* Chod.)

4,8 µm gross. Wegen der eigenartigen Coenobienbildung ist es der Publikation würdig. — Tafel I, Abb. 12=Csorna-Foktőer-Kanal, 13. 5. 1971.

23. *S. intermedius* var. *balatonicus* Hortob. — Alternierende 4-zellige Coenobien von $7{,}5-9\times3-5$ µm grossen ovoiden oder ein wenig unregelmässig ellipsoiden

Zellen. Eine der lateralen Zellen hat manchmal nur auf einem Ende einen Stachel (Tafel IV, Abb. 65). Auch dieses Taxon gibt ein gutes Beispiel dafür, dass die aus natürlichen Wasserproben in Ungarn beschriebenen *Scenedesmus*-Taxa wohl umgrenzt sind und auf ihr wiederholtes Vorkommen in verschiedenen Gewässern gerechnet werden kann. — Tafel I, Abb. 13=Szelider-See, 26. 3. 1973, Tafel IV, Abb. 65=Kígyós-Bach, 16. 11. 1972.

24. *S. opoliensis* P. RICHT. — Meinen älteren und auch jetzt demonstrierten Beobachtungen nach hat man innerhalb der Art auch auf solche Morphotypen zu zählen, bei denen nur einer der Pole „abgestutzt" ist. In einem der hier demonstrierten Beispiele fügen sich die intermediären Zellen auf eine bei dieser Art ungewöhnliche Weise eng aneinander (Tafel IV, Abb. 62), während in unserem anderen Beispiel das Coenobium von lockerem Aufbau ist. Alle Zellen sind am einen ihrer Enden breiter, an dem anderen Ende verschmälert (Tafel IV, Abb. 59). Die 8-zelligen Coenobien bestehen in beiden Fällen aus zwei alternierend symmetrisierenden Hälften. In unserem Material wurden auch die monodesmoiden, *Chodatella*-artigen Exemplare der Art gefunden (Tafel IV, Abb. 55, 61), bei denen die „Abgestuhzheit" eines der Pole oder beider Pole die Artzugehörigkeit unzweifelhaft macttt. — Tafel IV, Abb. 59=Bajaer Kamarás-Donau, 10. 5. 1972, Tafel IV. Abb. 55=Donau bei Baja, 9. 8. 1975, Tafel IV, Abb. 61=Donau bei Baja, 9. 8. 1975, Tafel IV, Abb. 62=Bajaer Kamarás-Donau, 10. 5. 1972.

25. *S. protuberans* FRITSCH — Die intermediären Zellen sind kürzer als die lateralen und haben — der originalen Beschriebung gegenüber — im Falle des beobachteten Exemplars keine Zähne auf ihrem Pol. — Tafel III, Abb. 45=Kígyós-Bach, 7. 6. 1971.

26. *S. protuberans* FRITSCH var. *procerus* UHERK., nova var. — Im 4-zelligen Coenobium sind die lateralen Zellen 20–30×2,5–4,5 μm, die inneren Zellen 18–24×4,5–8 μm gross. Die lateralen Zellen enden in einem mehr oder weniger gut entwickelten Köpfchen. Auf beiden Polen der lateralen Zellen sitzt je ein zellenlanger oder ein wenig noch längerer, kräftiger, bogenförmig gekrümmter Stachel. Es ist am merkwürdigsten im Coenobienaufbau, dass die zwei intermediären Zellen miteinander und mit den lateralen Zellen nur auf einer sehr kurzen Strecke, auf 1/4–1/8 Zellenlänge verbunden sind und dass die intermediären Zellen im Verhältnis zu der Längsachse des Coenobiums schief stehen. Es unterscheidet sich von der Art mit diesem Zeichen des Coenobienaufbaus und mit der grösseren Schlankheit der lateralen Zellen (Ikonotyp=Tafel III, Abb. 43). Diese Alge kam schon früher wohl umgrenzbar in den von uns untersuchten Gewässern vor (UHERKOVICH—SCHMIDT—VÖRÖS 1975, SCHMIDT 1976b). Wir haben bereits erwähnt, dass wir die Alge für eine von der Art abweichende Form halten, aber ihre formelle taxonomische Absonderung hatten wir dann noch nicht ausgeführt. Nach der wiederholten sorgfältigen Beobachtung des Organismus kann jetzt auch dies an die Reihe kommen. Bei der jetzigen Besprechung des Taxons weise ich gleichzeitig auch auf SCHMIDTS Abbildung 1976b Abb. 22 zurück. — Tafel III Abb. 39=Sió-Mündung, 6. 5. 1971, Tafel III, Abb. 43=Bajaer Kamarás-Donau, 11. 5. 1972, (zur selben Zeit auch in den Wasserproben der Donau gefunden).

Scenedesmus protuberans FRITSCH var. *procerus* UHERK. nova var. — Coenobia 4-cellularia, e cellulis extimis 20–30×2,5–4,5 μm, et mediis 18–24×4,5–8 μm constructa. Cellulae extimae in polis ambobus plus-minus conspicue capitulatis spinis singulis crassis, arcuatis, longitudinae cellulae aequalibus vel parum longioribus. Cellulae mediae in comparatione ad axem longitudinalem coenobii obliquae, inter sese et extimas parte 1/4–1/8 longitudinis tantum conjunctae. A specie typica

Tafel IV

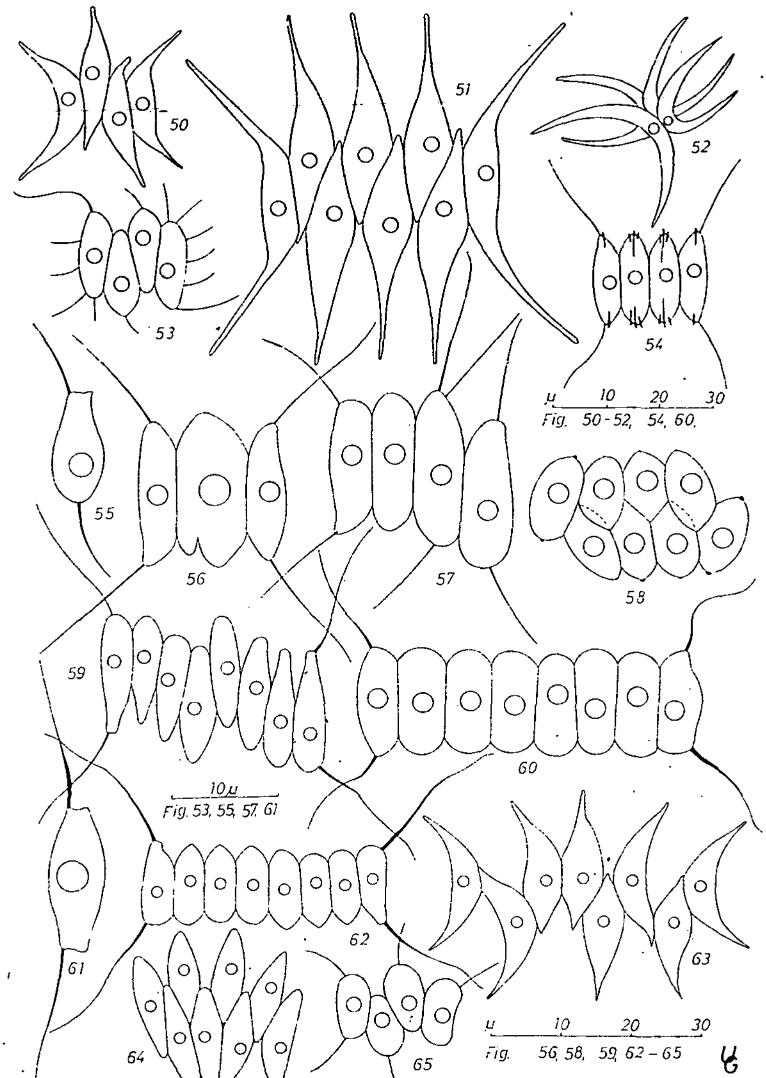

Abb. 50—65. 50. *Scenedesmus acuminatus* (LAGERH.) CHOD., 51. *S. acuminatus* (LAGERH.) var. *acuminatus* f. *maximus* UHERK., 52. *S. acuminatus* (LAGERH.) CHOD. var. *elongatus* G. M. SMITH, 53. *S. spinosus* CHOD. var. *bicaudatus* HORTOB., 54. *S. carinatus* (LEMM.) CHOD., 55. *S. opoliensis* P.RICHT.,56. *S. quadricauda* (TURP.)BRÉB.,J 57. *S. quadricauda* (TURP.) BRÉB. var. *setosus* KIRCHN., 58. *S. apucilatus* (W. et G. S. WEST) CHOD. var. *apiculatus* f. *disciformis* UHERK., nova forma, 59. *S. opoliensis* P. RICHT., 60. *S. quadricauda* (TURP.) BRÉB., 61—62. *S. opoliensis* P. RICHT., 63. *S. acuminatus* (LAGERH.) CHOD. var. *bernardii* (G. M. SMITH) DEDUSS., 64. *S. baculiformis* CHOD., 65. *S. intermedius* CHOD. var. *balatonicus* HORTOB.

constructione coenobiorum deinde cellulis extimis magis proceris distincta. (Iconotypus=fig. nostr. III. 24.)

27. *S. quadricauda* (TURP.) BRÉB. — Ich bringe hier je ein Beispiel aus unserem

Material einerseits für die verhältnismässig seltenere 8-zellige Erscheinungform, die übrigens die gewöhnliche Bestachelung hat (Tafel IV, Abb. 60), andererseits für die auf einem der Pole mit einem Doppelstachel versehene unregelmässige Form (Tafel III, Abb. 34) und endlich für ein eigenartiges Coenobium, das jeder Wahrscheinlichkeit nach gleichfalls zu diesem Taxon gerechnet werden kann und bei dem die Mittelzelle des 3-zelligen Coenobiums eine morphologisch gut beobachtbare „zwillingswertige" Zelle ist (breite Zellform, grosses Pyrenoid, Einschnürung auf einem Pol) (Tafel IV, Abb. 56). — Tafel III, Abb 34=Kígyós-Bach, 1. 3. 1973, Tafel IV, Abb. 56=Karapancsaer Hauptkanal, 28. 6. 1976, Tafel IV, Abb. 60=Kígyós-Bach, 7. 6. 1971.

28. *S. quadricauda* var. *setosus* KIRCHN. — Diese Varietät wird von der Art durch die auf den intermediären Zellen des Coenobiums sitzenden langen Stacheln unterschieden. In den hier mitgeteilten zwei Beispielen ist das Coenobium nicht eines völlig geradlienigen Aufbaus, die zwei Hälften des Coenobium wurden im Vergleich zueinander ein wenig verschoben. — Tafel III, Abb. 48=Bajaer Kamarás-Donau, 10.3. 1972, Tafel IV, Abb. 57=Kígyós-Bach, 1. 3. 1972.

29. *S. regularis* SWIRENKO (=*S. coartatus* HORTOB.) — 4-zellige Coenobien von 3–4,3×13–17,5 μm grossen Zellen. Die Zellen sind spindelförmig, sie biegen sich mit ihren herausgezogenen, aber in einer stumpfen Spitze endenden verjüngenden Enden auf die Mittelachse des Coenobiums zu, d. h. nach innen. Mit diesem Merkmal ist dieser Organismus fast ein morphologisches Gegenstück des *S. acumivatus*-Typs. Eine der vier Zellen wird manchmal aus der Reihe gewissermassen verdrängt (Tafel I, Abb. 6). Wir halten die spezifische Absonderung dieses Taxons berechtigt und können mit der Auffasusng, wonach dieser Organismus zur Art *S. acutus* (=*S. obliquus*) gehören sollte, wie es z. b. KORSCHIKOV (1953, p. 378—379, Abb. 364/3) sich vorstellt, nicht einverstanden sein. — Tafel I, Abb. 5—8 Karapancsaer-Hauptkanal, 7. 6. 1976, Tafel I, Abb. 10=FRANZ-NÄHRKANAL, 22. 10. 1971.

30. *S. soói* HORTOB. var *exornatus* UHERK., nova var. — Ausdrücklich alternierende, 4-zellige Coenobien von 15–17×10–12 μm grossen, ovoiden Zellen. Es gibt auf den Polen der lateralen Zellen ein oder zwei 1,8–2,6 μm lange, manchmal ein wenig gekrümmte kleine Stacheln. Auf dem hinausragenden Pole der intermediären Zellen ist ein einziger kürzerer Stachel, auf ihrem anderen Pole sind 2—3 sehr kleine Zähne. Auf den lateralen Zellen, von den auf den Polen sitzenden Stacheln ausgehend, teils in der Kontur, teils auf die Flanken anlaufend sind aus winzigen Zähnchen bestehende zwei oder drei unvollständige, oder vollständige Reihen. Auf beiden Flanken der intermediären Zellen ist auch je eine solche unvollständige Zähnchenreihe. Von der Art, als vom Typ unterscheidet sich die Varietät durch die grössere Zellform und die reichere Oberflächenskulptur (Ikonotyp=Tafel I, Abb. 14). — Die Art ist ein Organismus sporadischer aber vermutlich weiterer Verbreitung, als es bisher gedacht war. Auch die von COMPÈRE (1976) publizierte afrikanische Vorkomnisse weisen z. B. darauf hin. Eine mit reicherer Oberflächenverzierung, mit mehreren Skulpturelementen versehene Varietät der Art ist die hier beschriebene Alge. — Tafel I, Abb. 14=Karapancsaer-Hauptkanal, 7. 7. 1975.

Scenedesmus soói HORTOB. var. *exornatus* UHERK., nova var. — Coenobia 4-cellularia, e cellulis late ovatis, 15–17×10–12 μm magnis, distincte alternantibus efformata. Cellulae extimae polis spinulis singulis vel binis, 1,8–2,5 μm longis, nonnunquam parum inclinatis, deinde 2–3 seriebus longitudinalibus denticulorum parvorum a spinulis polaribus partim in extremis lineis, partim in lateribus exeuntibus, pertim perfectis, partim imperfectis, ornatae. Cellulae mediae pilis exsertis spinulis singulis brevioribus, polis autem alteris 2—3 denticulis perparvis, lateribus ambosus seriebus singulis imperfectis denticulorum parvorum a polis alternanter exsertis exeuntibus. A specie typica cellulis majoribus sculpturave superficiei distincta (Iconotypus=fig. nostr. I. 14.)

31. *S. soói* HORTOB. — 12—13,5×6—7,5 µm grosse ellipsoide Zellen bilden 4-zellige Coenobien. Auf den Polen der lateralen Zellen je ein auf einem breiten Grund entspringender Stachel, der ein wenig kürzer ist als die Zellenlänge. Von den herausragenden Polen der intermedären Zellen ausgehend schmiegt sich eine kurze Oberflächenrippe (und kein Stachel, denn sie kann auf beiden Seiten beobachtet werden) an die Zellflanken. Auf dem anderen Pol der intermediären Zellen ist ein kleiner stumpfer Zahn. Unsere Beobachtungen ergänzen die originelle Diagnose in der Relation der Zellengrösse und in der Auslegung der intermediären Zellenornamentik. — Tafel III, Abb. 46 = Bajaer Kamarás-Donau, 23. 10. 1971.

32. *S. spinosus* CHOD. emend. UHERK. 1966. — Bei der Art ist die Anzahl der auf den Konturseiten sitzenden kleineren Stacheln (1—3), sowie auch ihre Länge sehr variabel, von dem kaum bemerkbaren kleinen Stachel (Tafel II, Abb. 19), ja auf einer der Zellen von dem völligen Mangel an Stachel ab (Tafel II, Abb. 22) bis zur gewöhnlichen Stachellänge. Es fehlt manchmal an einer der lateralen Zellen die Stachelbildung vollkommen, es gibt hingegen auf der bei ihr befindlichen intermediären Zellen zwei längere Stacheln (Tafel II, Abb. 23 = dieser Einzelorganismus vertritt einen morphologischen Übergang zum *S. spinosus* var. *danubialis*). — Tafel I, Abb. 2 = Donau bei Baja, 20. 7. 1976, Tafel II, Abb. 19 = Vadkerter-See, 23. 6. 1973, Tafel II, Abb. 21—22 = Donautal-Hauptkanal, 13. 3. 1972, Tafel II, Abb. 23 = Sió-Mündung, 14. 10. 1975.

33. *S. spinosus* var. *bicaudatus* HORTOB. — Es werden einige interessante Beispiele aus unserem Material zum morphologischen Reichtum der Varietät gebracht. — Tafel II, Abb. 17 = Sárközer I. Hauptkanal, 19. 7. 1976, Tafel II. Abb. 18 = Szelider-See, 15. 10. 1973, Tafel II, Abb. 20 = Sárközer I. Hauptkanal, 13. 3. 1972, Tafel IV, Abb. 53 = Karapancsaer-Hauptkanal, 5. 7. 1976.

34. *S. spinosus* var. *danubialis* HORTOB. — Tafel II, Abb. 24 = Donau bei Dunaföldvár, 24. 6. 1976.

35. *Scenedesmus* sp. 1. (*S. regularis* SWIRENKO forma?, *S. tibiscensis* UHERK. forma?) — Die lateralen Zellen sind 13 µm lang, die intermediären Zellen 15 µm lang, die Breite der Zellen ist 3,2—3,5µm. Das Ende der spindelförmigen Zellen ist nach innen gekrümmt. Unserem spärlichen Beobachtungsmaterial zufolge sehen wir die Morphologie der Alge nicht klar genug, deshalb müssen wir von ihrer formellen taxonomischen Absonderung absehen. — Tafel II, Abb. 33 = Donau bei Mohács, 9. 8. 1974.

36. *Scenedesmus* sp. (*S. brasiliensis* BOHLIN var. *quadrangularis* BORGE forma?, *S. armauts* CHOD. var *ecornis* WOLÓSZ. forma?) — Ein aus 15×5,5 µm grossen zylindrischen Zellen bestehendes 4-zelliges Coenobium. Die beiden Hälften des Coenobiums stehen zueinander ein wenig verschoben. Es gibt auf einem alternierend entsprechenden Ende der lateralen Zellen einen mit der Längsachse parallel stehenden kurzen (4 µm) kräftigen Stachel und ausserdem noch ein oder zwei kurze Zähne oder kleine Stacheln. Auf dem herausragenden Pole der intermediären Zellen sind zwei kurze schiefe Stacheln, auf dem anderen Pole 1—3 kleine Zähnchen. Auf den Flanken der lateralen Zellen sind je zwei Rippen. Auf der Seite der intermediären

Zellen je eine kräftige Rippe unregelmässigen Ablaufs. Dieser Organismus ist nur in einem einzelnen Coenobium beobachtet worden. Vermutlicherweise ist er ein neues Taxon, aber dem spärlichen Beobachtungsmaterial zufolge, konnte seine formelle taxonomische Absonderung natürlich nicht vorgenommen werden. — Tafel I, Abb. 3 = Karapancser-Hauptkanal, 28. 6. 1976.

Literatur

BISALPUTRA, T. — WEIER, T. E. (1963): The cell wall of Scenedesmus quadricauda. — Amer. Journ. Bot. *50*, 1011—1019.

BISALPUTRA, T.—WEIER, T. E.—RISLEY, E. B.—ENGELBRECHT, A. H. P. (1964): The pectic layer of the cell wall of *Scenedesmus quadricauda*. — Amer. Journ. Bot. *51*, 548—551.

CHODAT, R. (1926): *Scenedesmus*. Etude de génétique, de systématique expérimentale et d'hydrobiologie. — Revue d'Hydrologie *3*, 7—258.

COMPÉRE, P. (1976): Algues de la région du Lac Tchad, — Cah. O. R. S. T. O. M., Sér. Hydrobiol. *10*, 77—118.

FELFÖLDY, L. J. M. (1960): Comparative studies on photosynthesis in differt Scenedesmus strains. — Acta Bot. Acad. Sci. Hung. *6*, 1—13.

FELFÖLDY, L.—UHERKOVICH, G. (1965): Cutivation on the green algal strain 5618. *Scenedesmus obtusiusculus* in artificial sea water. — Annal. Biol. Tihany *32*, 255—264.

HINDÁK, F. (1974): The morphological variability of *Scenedesmus pannonicus* HORTOB. in culture. — Arch. Hydrobiol. Suppl. *46*, 130—139.

HINDÁK, F.—KLASOVA, A. (1974): Surface ultrastructure of the cell wall of *Scenedesmus grahneisii* (HEYNIG) FOTT. — Arch. Hydrobiol. Suppl. *46*, 163—170.

HORTOBÁGYI, T. (1967): Neue Beiträge zur Kenntnis der Scenedesmen in Ungarn. — Acta Bot. Acad. Sci. Hung. *13*, 21—60.

HORTOBÁGYI, T. (1969a): Phytoplankton organism from three reservoirs of the Jamuna River India. — Studia Biol. Hung. *8*, 1—80+I—XXXVI.

HORTOBÁGYI, T. (1969b): Algen aus Vietnam. IV. Chlorophyta, II. (Scenedesmen, Conjugatophyceae). — Acta Bot. Acad. Sci. Hung. *15*, 37—69.

HORTOBÁGYI, T. (1971a): On some new *Scenedesmus*. I. — Acta Biol. Acad. Sci. Hung. *22*, 375—384.

HORTOBÁGYI, T.: (1971b): On some new *Scenedesmus*. II. — Acta Biol. Acad. Sci. Hung. *22*, 385—391.

HORTOBÁGYI, T. (1973): The microflora in the settling and subsoil water enriching basins of the Budapest Waterwork. — Akadémiai Kiadó, Budapest.

KOMÁREK, J.—LUDVIK, J. (1971): Die Zellwandstruktur als taxonomisches Merkmal in der Gattung *Scenedesmus*. I. Die Ultrastrukturelemente. — Arch. Hydrobiol. Suppl. *39*, 301—333.

KOMÁREK, J.—LUDVIK, J. (1972): Die Zellwandstruktur als taxonomisches Merkmal in der Gattung *Scenedesmus*. 2. Taxonomische Auswertung der untersuchten Arten. — Arch. Hydrobiol. Suppl. *41*, 11—42.

MASJUK, N. P. (1958): Protokokkovi vodorosti oser sechidno-ukrainskogo Polisja. — Vid. Akad. N. URSR, Kiev, 1—58.

NECAS, J. (1976a): Clone selection of a coenobial chlorococcal alga during the first phases of its culture growth. — Arch. Hydrobiol. Suppl. *49*, 271—302.

NECAS, J. (1976b): Clone selection of unicellular algae in the first phases of their growth in the culture. — Arch. Hydrobiol. Suppl. *49*, 394—414.

PHILIPOSE, M. T. (1967): Chlorococcales. — ICAR, New Delhi.

RODHE, W. (1948): Environmental requirements of fresh-water plankton algae. — Symbol. Bot. Upsal. *10*, 1—149.

SCHMIDT, A. (1975): Újabb adatok a Szelidi-tó limnológiai viszonyaihoz (Neuere Daten zu den limnologischen Verhältnissen des Szelidi-Sees). — Hidrol. Közlöny *55*, 178—182.

SCHMIDT, A. (1976a): Adatok a Duna Baja környéki mellékágainak limnológiájához (Data on the limnology of the Danube arms around Baja). — Hidrol. Közlöny *56*, 273—280.

SCHMIDT, A. (1976b): Újabb adatok a Duna magyarországi szakasza algáinak ismeretéhez. — Környezetvédelem és Vízgazdálkodás '76 vándorgyűlés előadásai, MTESZ kiadv.

SCHMIDT, A. (1977): A Vadkerti tó limnológiai viszonyairól. — Hidrol. Közlöny (in lit.)

SCHMIDT, A.—UHERKOVICH, G. (1976): A Scenedesmus grahneisii (HEYNIG) FOTT magyarországi előfordulásáról. (Über das Vorkommen von Scenedesmus grahneisii.) — Botanikai Közl. *63*, 3—5.

SMITH, G. M. (1916): A monograph of the algal genus *Scenedesmus* based upon pure culture studies.— Transact. Wiscon. Acad. Sci. Arts Let. *18*, 422—530.

SWIRENKO, D. O. (1922): Mikroflora stojacich vodojemo, I. — Vseukr. Gossud. Isdat. Charkov-Jekaterinoslav, I.,II., III.

TRAINOR, F. R. (1963): Zoospores in *Scenedesmus obliquus*. — Science *142*, 1673—1674.

TRAINOR, F. R. (1966): A study of wall ornamentation in culture of *Scenedesmus*. — Amer. Journ. Bot. *53*, 995—1000.

TRAINOR, F. R.—BURG, C. A. (1965): Scenedesmus obliquus sexuality. — Science, 148: 1094—1095.

TRAINOR, F. R.—CAIN, J. R.—SHUBERT, L. E. (1976): Morphology and nutrition of the colonial green alga Scenedesmus 80 years later. — Bot. Rev. *42*, 5—25.

TRAINOR, F. R.—MASSALSKI, A. (1971): Ultrastructure of Scenedesmus strain 614 bristles. — Canad. Journ. Bot. *49*, 1273—1276.

TRAINOR, F. R.—ROSKOSKY, F. G. (1968): Scenedesmus wall ornamentation. IV. Apical openings and membranes. — Bull. Torr. Bot. Club *95*, 11—15.

UHERKOVICH, G. (1956): Adatok a Scenedesmusok magyarországi elterjedésének ismeretéhez. I. (Beiträge zur Verbreitung der Scenedesmus-Arten in Ungarn. I.) — Pécsi Pedag. Főisk. Évkönyve *1*, 227—246.

UHERKOVICH, G. (1960): Beiträge zur Kenntnis über das Vorkommen der Scenedesmus-Arten in Ungarn. II. — Acta Bot. Acad. Sci. Hung. *6*, 405—426.

UHERKOVICH, G. (1966): Die Scenedesmus-Arten Ungarns. — Akadémiai Kiadó, Budapest.

UHERKOVICH, G. (1968): Zur Chlorococcalen-Flora Finnlands. I. — Acta Bot. Fennica *82*, 1—26.

UHERKOVICH, G. (1970): Seston Wisly od Krakowa po Tczew (Über das Wisla-Phytoseston zwischen Kraków und Tczew). — Acta Hydrobiol (Kraków) *12*, 161—190.

UHERKOVICH, G. (1971a): A Tisza lebegő paránynövényei. (Die Mikrophytentrift des Flusses Tisza-Theiss.) — Szolnok Megyei Múzeumi Adattár *20—22*, 1—282+I—CXLIII.

UHERKOVICH, G. (1971b): Zur Chlorococcalen-Flora Finnlands. II. — Acta Botanica Fennica *94*, 1—22.

UHERKOVICH, G. (1973): Zur Chlorococcalen-Flora Finnlands. III. — Acta Botanica Fennica *99*, 1—18.

UHERKOVICH, G. (1974): Zur Limnologie der Stauseeen des Mecsek-Gebirges (A Mecsek tározótavainak limnológiájához). — Janus Pannonius Múzeum Évkönyve *19*, 7—30.

UHERKOVICH, G. (1976a): Algen aus den Flüssen Rio Negro und Rio Tapajós. — Amazoniana *5*, 465—515.

UHERKOVICH, G. (1976b): Die Mikrophyten des Rigóc-Baches und seiner Weiher (Komitat Somogy, Ungarn). — Dunántúli Dolgozatok (Pécs) *10*, 5—17.

UHERKOVICH, G.—KALKÓ, ZS.—FELFÖLDY, L. (1962): *Scenedesmus obtusiusculus* CHOD. alaktan tulajdonságai különféle tenyésztési körülmények között (Changes in morphology of Scenedes—mus obtusiusculus CHOD. under different culture conditions). — Annal. Biol. Tihany *29* 287—295.

UHERKOVICH, G.—SCHMIDT, A.—VÖRÖS, L. (1975): Adatok a Duna magyarországi szakasza algáinak ismeretéhez (Angaben zur Kenntnis der Algen im ungarischen Donauabschnitt). — Bot. Közl. *62*; 165—177.

UHERKOVICH, G.—SCHMIDT, G. W. (1974): Phytoplanktontaxa in dem zentralamazonischen Schwemlandsee Lago do Castanho. — Amazoniana *5*, 243—283.

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RESULTS OF THE ALGOLOGICAL INVESTIGATION OF THE SAJÓ BED STRETCH BELOW MISKOLC IN 1976

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Abstract

(1) It is to be established by reason of the results of the comparative algological investigation of the Sajó bed stretch below Miskolc that:

the original Hernád-bed of small water output ,owing to its rich algal population, increases the tychoplanktonical algal communities of the Sajó, while the Hernád factory canal of large water output may partially decrease it;

it is of definitive importance, at any rate, if the algae having got into the Sajó have found the favourable living conditions;

their joint effect is fundamental in the life of the Sajó and through this they may also influence the affected bed stretch of the Tisza.

(2) In the Sajó stretch below Miskolc trophity is increasing. This is the result of the increasing pollution.

(3) The algal population maximum, observed on the occasion of examining the longitudinal section on July 19—20, 1976, is of tributary origin but of a type of developing secondarily in the Sajó. Thus, apart from characterizing the tributaries, it is also showing well the water quality of the Sajó stretch before the discharge of the Sajó into the Tisza. Its correlation with the chemical "background" gives us information also of the correlation between trophity and saprobity.

(4) For the sake of protecting the quality of the Tisza water, the trophity of the Sajó is to be decreased what means a decrease also in the allochthonous materials.

Introduction

According to the investigations of the tychoplanktonical algal communities of the Sajó (VÁNCSA, 1977), the bed stretch of this river in Hungary falls into well-delimitable parts. The single stretches are characterized by the water-using, water-polluting activity of the man, as well as by the fundamental changes in water quality under the influence of tributaries.

The Sajó arrives at the area of Miskolc with a considerable pollution. The quality of its water is fundamentally changed here by the water-using, water-polluting activity of the man. The bed stretch below Miskolc is only loaded — in addition to the fundamental burden — by the sewage-waters of some minor settlements, resp. by the pollutions originating from the agricultural water-usage and the runoff from land. The double-mouth of the Hernád may casually considerably deteriorate the conditions of pollution and self-purification but it can also have a favourable effect on the water of the Sajó.

It follows from this that the conditions favourable from the point of wiev of self-purification can develop in the bed stretch between the inflow of the Szinva and Hernád and the realization of this process can be observed to a certain extent in the stretch free from these disturbing effects.

In this paper I render account of the results from the year 1976, emphasizing the changes to be observed in the stretch part below Miskolc, with special regard to the effect of the double Hernád-mouth on the Sajó and to the peculiarities of the algal population maximum observed at the investigation of the longitudinal section on July 19—20, 1976.

Discussion of the results of the investigation

I have examined the qualitative and quantitative composition of the tychoplanktonical algal communities of the Sajó from the water samples drawn also in 1976, with a monthly frequency, marked out according to my quoted paper, in ten sections considered as characteristic. I have casually investigated it in other sections, too, as well as the tychoplanktonical algal communities of the original Hernád-bed, the Hernád factory-canal, as well as the Takta canal, in their mouth sections. The aim of my work was not to study the algal taxons of rare occurrence but to observe and evaluate the algal population maxima that are suitable for being qualified. In this way, the algal taxons that may possibly have proved taxonomically new, fell, of course, into the background.

According to the investigations of the Sajó, performed in the year 1976, the change in the total algal number (Tables 1&2, as well as Fig. 1) is extreme: in three sections of the upper reaches it was also of atrophic character, while in the lower reaches on three occasions it was eu-, resp. polytrophic. (The qualification as "atrophic" does not exclude the possibility of that algae could occur in the three sections, too. Practically it means that in the microscopically examined water amount I have not found any algae; their total algal number is practically zero, and zero was also the chlorophyl *a* content!). On the basis of the total algal number, the water of the Sajó is characteristically mesotrophic.

It changes on the basis of the chlorophyl a content, being of atrophic or eutrophic character. In the upper reaches, the chlorophyl *a* content has never surpassed the oligo-mesotrophic grade, while in the lower reaches, in the spring-summer months, the water of the river Sajó was often found to be of mesotrophic, meso-eutrophic, and at the July maximum even of eutrophic character.

The cause of the expressly different trophity characters below Miskolc and above Miskolc is to be looked for first of all in the rich algal vegetation of the double Hernád-mouth and the Takta canal. On the other hand, the development of the own tychoplanktonical algal vegetation of the Sajó in the lower bed stretch may also be considerably supoprted by the slowing down of the river current, and this also takes part in the periodic increase of trophity grade.

The stock of the netted zooplankton (mostly Rotatoria) was of considerable quantity from April up to September, its maximum was observed in July what agreed well, in time, with the maximum time of the total algal number and the chlorophyl-*a* content. This could take place — in addition to the other environmental effects — as a result of the periodical abundance in nutritive materials (the considerably increased algal population). This is shown also by that it is in a good correlation with the quantitative changes in the algal population.

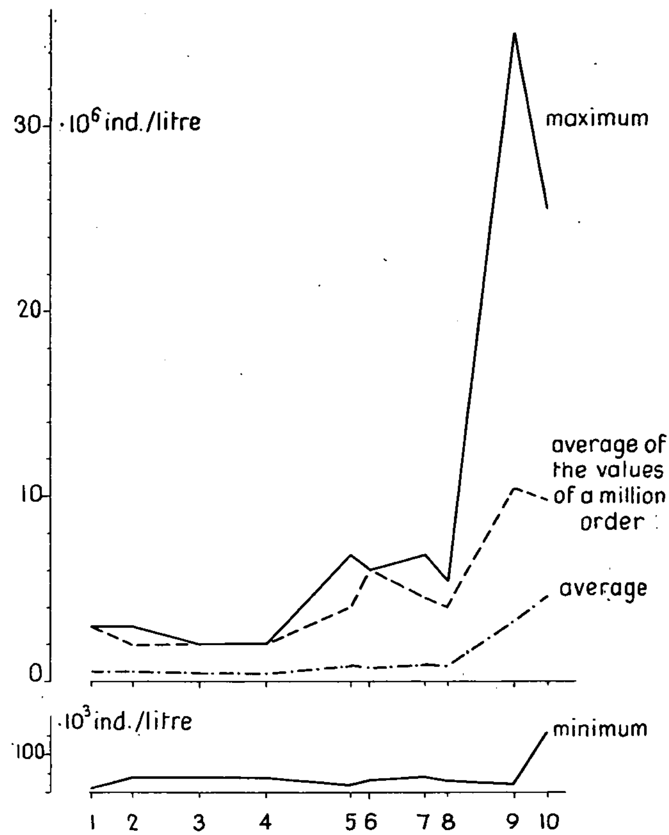

Fig. 1. Characteristic values of the total algal number of the Sajó (minimum, maximum, the average of values of a million order and of all values) in 1976.

In Figures 1 to 4, sampling sites 1 to 10 are represented in the scale of river-km, therefore the proper comparison of the distances between the single sections is possible.

On the basis of the saprobic index investigations (Fig. 2), the characteristic features of all the ten investigated sections are anyway referring with small deviations to a similar saprobic character but the most characteristic changes manifest themselves well. (At interpreting the Figure, it is to be taken into consideration that it does not show any simultaneous values but annual peculiarities observed in the ten investigated sections. The changes are, in my opinion, well shown by the Figure).

On the basis of the microscopic examinations, the saprobity of the Sajó is most unfavourable in the frontier section (Sajópüspöki) and most favourable in the mouth section (Ószederkény). At the same time, the effect of the Miskolc area, influencing the water quality presents itself well, there are appearing fundamental changes in the shorter or longer bed stretches below the mouths of the original Hernád-channel and the Hernád factory-canal, as well as the Takta canal, too.

Seasonally no characteristic connection appears but, as compared with the earlier years, it can be ascertained that the saprobity of the Sajó water has not changed in a characteristical degree. (The importance of performing saprobic

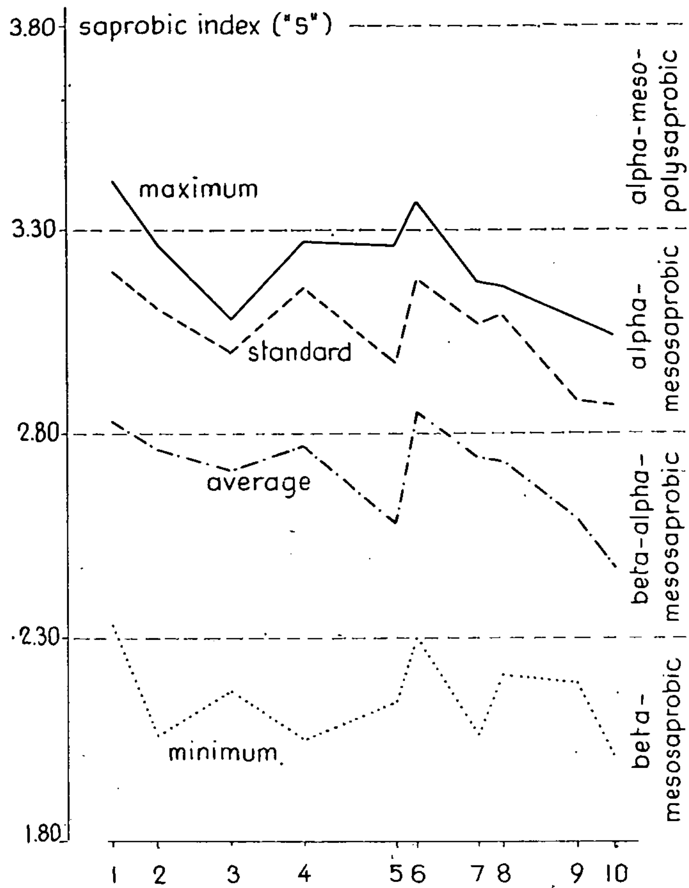

Fig. 2. The characteristic saprobic-index ("S") values of the Sajó (minimum, maximum, standard and average) in 1976.

investigations is — in spite of the several counter-arguments against the method — therein that in the course of this the microscopic living world of the water is examined in a living state — what is, of course, useful for forming an opinion of the water.)

The characteristics of the change in trophity-saprobity of the Sajó (Table 2) are of changing character in opposite direction to each other:

The *minimum values* of the *total algal number* (Fig. 1) are characteristically of *ten thousand* order of magnitude, they have only before the mouth a value of a hundred thousand. Their *maximum values* are characteristically of *a million* order of magnitude but in the bed stretch before the mouth their value is of *ten million* order of magnitude. The formation of the average values calculated on the basis of the million litre numbers *approximates the maximum value.* But it is somewhat more equalized in the stretch before the mouth. The formation of mean values calculated on the basis of a million litre numbers *approaches the maximum value,* and in the stretch before the mouth it is a little more equalized. The formation of

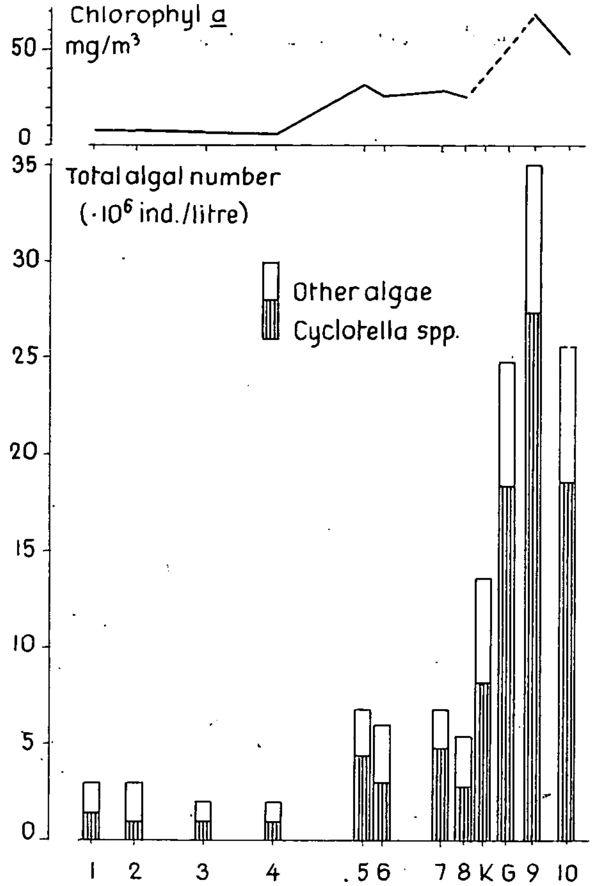

Fig. 3. The tychoplanktonical algal community of the Sajó on July 19—20, 1976.
In Figure 3, the sections investigated apart from sampling sites 1 to 10, between sections and 9, are: K=Köröm and G=Girincs (cf. also with Table 3).

mean values calculated from the results of all the investigations approaches the minimum values but with a difference in the order of magnitude because the mean values calculated from the total result of investigations are characteristically of a *nundred thousand order* of magnitude. They are only in the stretch before the mouth of a million value.

The minimum values of the saprobic index (Fig. 2) are indicating *beta-meso-saprobity,* being different only in the frontier section. Its maximum values are characteristically of *alpha-mesosaprobic* character. The Sajó is only in the frontier sector and in the area of Felsőzsolca of alpha-saprobic- polysaprobic intercultural character. The standard saprobic index values, calculated on the basis of the least favourable values, being in a definite proportion to the total examination number (grouped with the exception of Spring according to seasons) approach the maxima, indicating alpha-mesosaprobity. From the mean values calculated from the results of all the investigations follows a comparatively equalized alpha-mesosaprobic — beta-mesosaprobic character, an exception being the frontier section and the area of

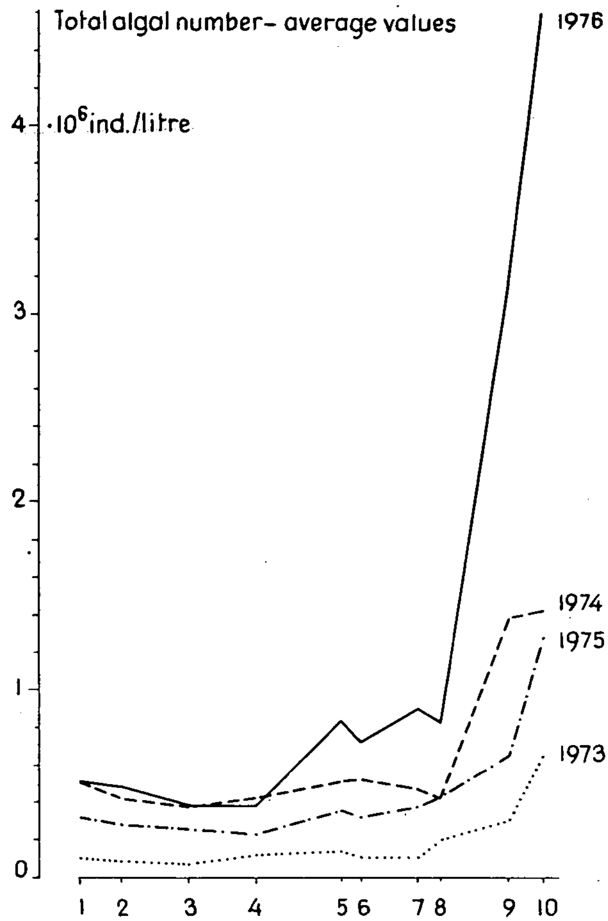

Fig. 4. Change in the trophity degree of the Sajó between 1973 and 1976, on the basis of the averag values of the total algal number (.10³ indiv./litre).

Felsőzsolca where the alpha-saprobity comes through the lower limiting value of alpha-mesosaprobity, as well.

The reciprocity of trophity-saprobity (Table 2, as well as Figures 1& 2) is duly informing us of the dynamism of the water quality conditions. It is evident that, simultaneously with the *decrease in saprobity,* trophity increases what may have been a natural consequence of the dissolved inorganic materials increasing together with the decrease in the amount of the solvable organic materials. (In case of the Sajó, a considerable amount of biologically resolvable allochtonous organic materials may be considerably decomposed in the food-chain of water — this is shown by the presence of a high number of heterotrophic living organisms and — as a nutritive material available to the autrophic plants — it can considerably increase the trophity of water.)

Evaluation of the investigation of the longitudinal section on July 19—20, 1976

Corresponding to the experiences of earlier years (1965 to 1975), the effect of the double Hernád-mouth is manifesting itself in 1976, as well, in the Sajó — in the short bed stretch before its flowing into the Tisza — as demonstrated well (apart from those told previously and the above-cited examples) by the characteristics of the investigation on July 19—20, 1976 of the longitudinal section (Table 3& Fig. 3).

At investigating into the longitudinal sector, in the stretch above Miskolc the Sajó had an equalized water output and the water output was similar to this — although somewhat smaller — up to Keszńyéten. This output was not changed by the small water quantity from the original Hernád-bed but the inflow of the Hernád factory canal was of fundamental effect. This has increased the water output of the Sajó (Q=about 5.0 cc.m/sec) to about three times as much value (Q=about 15.0 cc.m/sec) by its double water output (Q=about 10.0 cc.m/sec), in its short bed stretch before the mouth.

It turns out from the results of the investigation that the original Hernád-bed — in spite of its small water output — induces great changes owing to its rich algal vegetation but the development of the algal population maximum takes only place in the water of the Sajó. In the Sajó bed stretch below the original Hernád-bed the algal population increase continuously more and more and — as compared to the total investigations performed in the full Sajó stretch in Hungary — culminate in the maximum value reached so far ($35 \cdot 10^6$ individual/litre), at Kesznyéten. The Hernád factory canal decreases, by its considerable water output, the amount of the algal population maximum in the Sajó, and even before the inflow into the Tisza it is of considerable value.

The characteristic and dominat organisms of the observed tychoplanktonical algal community are diatom (Bacillariophyceae-Centrales) species (*Cyclotella* spp.). Besides these, they were enriched by the occurrence of several green algae (Chlorophyta), with changing individual number.

By the proliferation of *Cyclotella* spp. KÜTZ. in the Sajó, to an extent like this, the water properties which are favourable for us and may be attributed to the hydrological and ecological peculiarities of the river, are indicated unambigously, the results being manifested, however, in the Tisza, as well.

The chemical "background" is in a good correlation with the algological changes, showing also the effect of the double Hernád-mouth; namely:

the quantity of *dissolved oxygen* (in saturation percentage!) is large in the original Hernád-bed (152 per cent), above this, in the Sajó (35 per cent) it is comparatively small but in the section of Kesznyéten (90 per cent) the oxygen-producing effect of the increasing algal population is already to be felt and it is similarly considerable in the Hernád factory canal (117 per cent), as well as in the stretch of the Sajó before its mouth (88 per cent);

the *biochemical oxygen requirement* (five days long), changing according to this, is indicating the oxygen requirement of the algal population maximum, as well; (the pH value is equalized, ecologically acceptable);

the *total dissolved material* content in the original Hernád-bed and the Hernád factory canal is approximately of the same value and smaller than in the Sajó where thr amount of the dissolved material is of decreasing character;

the amount of the ammonium nitrate ions is of decreasing, resp. increasing character; indicating well the decomposition of organic materials;

the amounts of dissolved ortho-phosphates in the original Hernád-bed and the Hernád factory canal are equally of small value and of approximately identical quantity; in the Sajó, however, it is considerably larger and, in harmony with the running up of the algal population maximum, considerably decreases.

All the algal litre values of the Sajó in 1976 can characteristically be expressed with a hundred thousand order of magnitude; the minimum observed in the winter months (apart from the three atrophic values) is of ten thousand order, while the maxima are of a million — ten million value. The latter ones appear, in most part of cases, in the stretch below the double Hernád-mouth as algal population maxima, originating from tributaires but developing also in the Sajó secondarily and being observable in the Tisza, as well.

The trophity degree of the Sajó the basis of the investigations in the year 1976

At evaluating the trophity degree, I consider the maximum values as characteristic although the materials getting into the Sajó and increasing trophity go on with the flood. And on the occasion of large waters, the bed can strongly be washed through. It is, at any rate, to be taken into consideration that the water mass characterized as the maximum value may be the inducer of fundamental changes in the further bed stretches — or indirectly in the water mass of the Tisza. I hold, therefore, to be advisable — similarly to the qualification of standing waters — to consider the maxima as characteristic.

By the change in the trophity degree of the Sajó, it is characteristically shown on the basis of the average values (Fig. 4) that — considering the total algal number values of 1973 as the basis of comparison — it is of increasing character of late years. From the frontier section down to the area of Miskolc it is equalizedly of similar character, from Miskolc down to the inflow of the original Hernád-bed it is likewise equalized but perceptably larger, while in its bed stretch below the double Hernád-mouth the sudden change manifests itself in a remarkable degree. (On the basis of the mathematical average values of the whole investigation — aside from the larger or smaller changes — we may obtain similar results in respect of the changes in the trophity degree of the Sajó.)

The changes in the trophity degree can be explained with the following:

the natural (self-) purification of the Sajó is of sufficient extent, thus the amount of the dissolved nourishments is increasing. In earlier years (VÁNCSA 1975) the self-purification of the Sajó was impeded, resp. decreased by some toxic (?) effect. Of late, however, an effect like this has not been observed;

from the sewage farms functioning in the water system of the Sajó — owing to the improvement in the degree of efficiency — more dissolved nutritive material gets into the Sajó immediately or through the tributaries;

the amount of the dissolved nutritive materials, runoff from the watershed area of the Sajó and originating from the agricultural activity, is also increasing.

The results are useful in investigating the water quality of the Tisza because the pollutions of the Sajó exert their effect in the Tisza at last. The investigation into the double Hernád-mouth is therefore important.

The double Hernád-mouth can be characterized — apart from the existing similarities — with considerable qualitative and quantitative differences. The peculiarities of primarily hydrological character, coming about from the division of

Table 1. *Values of the total algal number of the Sajó (.10 indiv./litre), in 1976.*

Date of the investigation	Sajópüspöki	Putnok	Sajókaza	Sajószentpéter	Miskolc	Felsőzsolca	Sajólád	Ónód	Kesznyéten	Oszederkény
02.09—10.	39	39	49	68	117	78	117	107	156	156
02.24—26.	204	195	88	126	146	126	146	175	175	350
03.16—17.	370	175	156	175	195	156	165	107	272	282
04.05—07.	875	1031	661	574	1021	836	486	681	282	—
05.03—04.	535	496	340	311	642	428	798	827	564	1012
05.13.	—	—	—	—	—	—	2198	2373	2821	1642
05.24—25.	603	564	817	924	584	564	691	613	1284	—
06.01—02.	389	272	311	214	389	292	195	253	564	350
07.08.	—	—	—	—	—	—	—	—	—	18479
07.19—20.	3015	2918	2042	2042	6711	5933	6808	5447	35014	25579
08.09—12.	340	282	272	350	593	661	467	515	2480	1848
09.20.	165	185	97	88	185	195	272	282	214	224
10.25—26	68	88	58	49	107	78	117	58	136	—
11.02—03.	58	58	39	39	58	49	49	68	146	321
12.14—15.	10	0	0	0	20	30	39	30	20	—
minimum	10	39	39	39	20	30	39	30	20	156
maximum	3015	2918	2042	2042	6711	5933	6808	5447	35014	25579
mean value of a million order	3015	1975	2042	2042	3866	5933	4503	3910	10399	
average of all values	513	485	379	382	828	725	896	824	3152	4568

Table 2. *Characteristics of the change in trophity-saprobity of the Sajó in 1976, the total algal number (10^3 indiv./litre) and saprobic index (‚'S") fro the characteristic (minimum, maximum, standard, average) values*

	Sajópüspöki	Putnok	Sajókaza	Sajószentpéter	Miskolc	Felsőzsolca	Sajólád	Ónod	Kereszn yéten	Ószederkény
Trophity										
minimum	10	39	39	39	20	30	39	30	20	é6e
maximum	3015	2918	2042	2042	6711	5933	6808	5447	35015	25579
average of the values of a million order	3015	1975	2042	2042	3866	5933	4503	3910	10399	9712
average of all values	513	485	379	382	828	725	896	824	3152	4568
Saprobity										
minimum	2,33	2,06	2,17	2,05	2,14	2,30	2,06	2,21	2,19	2,01
maximum	3,42	3,26	3,08	2,37	3,25	3,36	3,17	3,16	3,08	3,04
[[standard"	3,20	3,11	3,00	3,16	2,97	3,18	3,07	3,09	2,88	2,87
average of all the values	2,83	2,76	2,71	2,77	2,58	2,85	2,74	2,73	2,59	2,47

Table 3. *Characteristic results of the longitudinal-section investigation of the Sajó on July 19—20, 1976*

	Water ouput (m^3/sec)	Total algal number (10^3)	Cyclotella spp. (liter)	Cyclotella (in percentag)	Chlorophil *a* (mg/m^3)	Saprobic index ("S")
Sajópüspöki	5,9	3 015	1 362	45	7,6	2,74
Putnok	6,3	2 918	973	33	8,3	2,68
Sajókaza	6,3	2 042	1 070	52	6,5	2,39
Sajószentpéter	5,9	2 042	1 070	52	5,6	2,93
Miskolc	4,0	6 711	4 377	65	32,2	2,18
Felsőzsolca	4,5	5 933	3 015	51	26,2	2,70
Sajólád	4,5	6 808	4 668	69	29,3	2,40
Ónod	4,5	5 447	2 723	50	25,9	2,38
original Hernád-bed	0,5	71 972	42 794	59	—	—
Köröm	5,0	13 640	8 170	60	—	—
Girincs	5,0	24 730	18 285	74	—	—
Kesznyéten	4,5	35 014	27 233	78	67,8	2,51
Hernád factory canal	0,0	40 849	29 178	71	—	—
Takta canal	0,3	9 629	973	10	—	—
Ószederkény	14,8	25 579	18 479	72	48,5	2,65

Table 4. *Change in the trophity degree of the Sajó between 1973 and 1976, on the basis of the average values of the total algal number (10^3 indiv./litre)*

	Sajópüspöki	Putnok	Sajókaza	Sajószentpéter	Miskolc	Felsőzsolca	Sajólád	Ónod	Kesznyéten	Ószederkény
1973	107	86	66	124	143	110	112	112	305	653
1974	500	414	366	418	507	515	468	421	1376	1412
1975	317	275	264	226	345	315	373	429	642	1266
1976	513	485	379	382	828	725	896	824	3152	4568

the bed stretch of the Hernád below the mouth, are also of fundamental consideration for the tychoplanktonical algal communities.

Taking into consideration that all the algal litre-number values of the Sajó are characteristically of a hundred thousand order of magnitude, and at the same time, in case of the double Hernád-mouth this value is characteristically of a million order of magnitude, it is easy to understand that in the bed stretches of the Sajó, following the confluence of their mostly similar water amounts, the total algal litre-number of the Sajó considerably increases already from the beginning. At the same time, the algal population maximum passing in the original Hernád-bed (in spite of its low water output) may exert a considerable effect in the water of the Sajó. It is shown by this fact unambiguously that the water quality in the bed stretch before the mouth is primarily determined by the effect of tributaries and it is only casually the result of the natural biological processes in the Sajó.

References

FELFÖLDY, L. (1974): A biológiai vízminősítés (Biological water qualification). — Vízügyi Hidrobiológia,No. 3, VIZDOK, Budapest.

VÁNCSA, A. L. (1975): A Sajó vízminőségi jellemzése biológiai vizsgálatok alapján. (Water-quality characterization of the Sajó, on the basis of biological investigations). — Hidr. Közl. *55*, 341—346.

VÁNCSA, A. L. (1977): A Sajó tychoplanktonikus algaegyüttesei (Tychoplanktonical algal communities of the Sajó). Material accepted for being published in TISCIA. As a lecture it was delivered on sessions of the XII-th Biological Itinerant Meeting and the VIII-th Tisza Research Conference.

Addition to the interpretation of Tables

(1) Sajópüspöki (frontier section)
(2) Putnok
(3) Sajókaza
(4) Sajószentpéter
(5) Miskolc
(6) Felsőzsolca
(7) Sajólád
(8) Ónod
(9) Kesznyéten
(10) Ószederkény (before the mouth)

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LIMNOLOGICAL CHARACTERISTICS OF THE TISZA STRETCH AT KISKÖRE DAM IN 1975

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Abstract

The work is dealing with the physical, chemical, and biological conditions of the middle — dammed up — stretch of the Tisza, as reflected in the flow regimen characterictic of the year 1975 taking into consideration the passing of flood-waves and the effect of dammings.

Materials and Methods

For studying the water of the Tisza, samples were taken in the reaches between Tiszakeszi and Tiszaroff (467—380 river km), with a fortnightly, resp. at Tiszakeszi a monthly, frequency. Samplings took place on the days February 12, 25, March 11, 25, April 8, 22, May 6, 20, June 2, 12, July 2, 15, 25, August 12, 26, September 21, October 14, 21, November 3, 18, December 2, 16.

For the chemical analyses there was taken 5 l drawn sample. A special sampler was used to determine the dissolved O_2 and the free CO_2. A large part of the components were determined on the sampling day, on the basis of the VITUKI (1970) and Felföldy's works (1974). At the river barrage, the water quantity transmitted per hour was read off from diagrams made by the VIZITERV, taking into consideration the position of the piston rod, resp. the water consumption of the turbine.

The total bacterial count was determined with a direct method (0.45_{μ}), (Sartorius membrane filter). The algae were prepared from drawn water, fixed with Lugol's solution. Chlorophyll was determined by being dissolved with mentanol (FELFÖLDY 1974). The zooflagellates were determined from living samples, from the netted and formalin-fixed samples of Rotatoria and Crustacea.

Results

Physical conditions

The formation of the Tisza flow regimen in 1975 was primarily determined by the comparatively mild Winter of 1974, poor in precipitation, the rainfalls in the early Spring, as well as by the changing Summer and Autumn weather.

In the mountains and hills of the Tisza watershed area, the sparse snow cover may have got a very sudden thaw. In the Tisza and its tributaries, a flood of rapid course already began in late December and culminated at Kisköre with a water output of 1,346 cc.m/sec, on January 5.

As a result of rainfalls in the early Spring, the first flood-wave of the so-called green- (spring-) flood began in early March, being one day after the flood of the

Bodrog and two days ahead of the flood of the Sajó. Culmination followed at Kisköre on March 18, with 920 cc.m/sec water output.

The second and third flood-wave of the spring-flood — meaning the greatest flood of 1975 — passed till Tiszalök in a well-separable form. The river barrages at Tiszalök and Kisköre have induced the union of flood-waves, by regulating the downflow of water masses, equalizing the fluctuations of water output, and decraesing their rapid downflow.

In the formation of the second flood-wave, the water mass arriving from the watershed area of the Upper-Tisza region, and the water mass transported by the Szamos have primarily played a role. The flood-wave, passing through the section at Vásárosnamény in 15 days, represented 1.2 thousand million cc.m water quantity and culminated with 1,760 cc.m/sec, on April 6.

The third flood-wave at Vásárosnamény meant about 1.5 thousand million cc.m water mass in 23 days. It is characteristic of its slower course that it culminated with only 1,270 cc.m/sec water output on April 18.

The flood of the Bodrog supplied, in 35 days, 1,2 thousand million cc.m, that of the Sajó, in 17 days, 266 million cc.m water into the Tisza.

The second and third flood-wave passing in the section of the Kisköre river barrage lasted for 43 days and culminated with 2,223 cc.m/sec on April 24. During this time, the water mass flowing through was 5,3 thousand million cc.m.

With the passing of the spring-flood, the flood-period of the year 1975 came to an end. As a result of the changing summer and autumn weather, smaller flood-waves often passed in the course of the year but their water quantity is not considerable.

The "small-water period" which is characteristic of the Tisza, only lasted from late September until the middle of October.

In 1975, only 16.8 thousand million cc.m water passed in the Kisköre section. The river barrage was dammed for 317 days. For 48 days — when the floods were passing — the Tisza flew in natural state.

Suspended matter content of the Tisza

On the basis of the systematic investigations in 1974, it was established that the suspended matter, content of the Tisza is a very important parameter for the water quality of the reservoir (Cf. VÉGVÁRI, 1976).

Investigating into the connections between flow regimen and the suspended matter content, we could ascertain that the largest drift mass was transported by the ascending line of the flood-wave (cf. Fig. 1). Before culmination this decreases and remains at an approximately standing little value until the flood-wave had passed (Fig. 1). On April 8, 1975, on the basis of the water sample taken from the ascending line of the spring-flood, the suspended matter content of the water passing through the Kisköre section surpassed 1 ton/sec. Then the water output of the Tisza was still 1,341 cc.m/sec. On April 22, after the culmination of the flood-wave, even at 2,151 cc.m/sec water output, there was passing not more than 150—200 kg/sec floating matter.

If filling takes place from the ascending line of flood-wave, then 200—300 thousand ton floating drift gets into the reservoir, together with 300 million cc.m water. Is filling beginning after the culmination of flood-wave, then the floating matter getting into the reservoir is a tenth of the former one. It is decreasing thus to 20 to 30 thousand ton. It follows from the data unambiguously that — if technically realizable — it is advisable from the point of view of water quality to begin filling the reservoir after the culmination of the flood-wave.

Water-chemical conditions

It is unequivocally verified by the results of the systematic investigations of 1974 and 1975 that the total iron content transported by the Tisza water is of mineral origin. Its quantity changes — as a result of the geochemical character of the reservoir of the Tisza and tributaries — in a close connection with the suspended matter content.

The total iron content transported by the Tisza is well represented by the data measured at the spring-flood. On the basis of the sample taken on April 8, 1975, from the ascending line of flood-wave, at 1,341 cc.m/sec water output, the total amount of iron flowing through the Kisköre section was 37.8 kg/sec. In the same place, on April 22, after the culmination of flood-wave, with 2,151 cc.m water output, 6.3 kg/sec flew down. It can be calculated from the results that from the sediment of the reservoir filled out of the ascending line of the flood-wave 8—9 thousand ton iron, while from the water arriving after the culmination 800—900 ton iron may get into the reservoir.

In 1975, because of the extreme water course and the high floating-matter content, the photosynthetic oxygen production of the water was negligible. The dissolved oxygen content of the Tisza was influenced primarily by weather (temperature) factors and the quantity of the atmospherical oxygen dissolved in the course of water movements.

Then oxygen supply of the Tisza water was favourable in the great part of the year, its oxygen saturation varied between about 80—100 per cent. Values about 40—60 per cent were only measured in a few cases. It can be established by reason of the annual datum-series that the change in temperature conditions can be well perceived at the seasonal changes in the dissolved oxygen content. There were measured in the winter and spring periods higher, in Summer and early Autumn lower values. In the course of the whole year, corresponding to the literary data (B. TÓTH 1976), the oxygen dynamics characteristic of river-waters could be observed.

The typical river-water character was represented by the change in the free carbon dioxide, as well. In flood time there were generally measured higher (between 9—11 mg/l), in the small-water period, however, lower values (5—7 mg/l).

The seasonal dynamics of the carbon dioxide content was considerably influenced by the concentrations of hydrogen-carbonate, calcium, magnesium, etc., transferred by the Tisza and its tributaries.

The change in the chemical oxygen needs of the Tisza generally depends on the different flow regimen conditions because the ratio of the organic component in the suspended matter transferred by the water is very high in flood-time, raising in this way the chemical oxygen demand considerably.

The values of the chemical oxygen demand ,measured with acid potassium permanganate, generally varied between 4 and 6 mg/l. At samples taken from the ascending line of floods, 10—14 mg/l quantities were measured.

The chemical oxygen demand, measured with acid potassium dichromate, varied between 19—22 mg/l. In case of a water of a larger suspended matter content, it achieved even 39.6 mg/l.

According to our calculations, the chemical oxygen demand of the reservoir filled in from the ascending line of the spring flood-wave, and measured with acid potassium permanganate, would however be, on the basis of the water sample from April 8, 1975, 4,260 ton. On the other hand, the momentary dissolved oxygen content would only be 3,264 ton. According to the datum-series, measured on April 22, 1975, after culmination, the chemical oxygen demand, calculated for 300 million cc.m water, turned up to be not more than 5,500 t, with an O_2 content similar to the previous one. In this case, even a part of the momentary dissolved oxygen content of the water is sufficient to decompose the organic matter getting in together with the supplied water, so that 6.88 mg/l dissolved oxygen has still remained as an excess. Although the data are reflecting a momentary situation, — the natural purifying of the Tisza being a result of more complicated processes, demanding a longer time — it can be established, at any rate, that in the interest of the undisturbed oxygen circulation, it is advisable to begin the filling of the reservoir after the flood-wave having culminated.

The dynamics of the mineral-matter content of the Tisza was primarily determined by water courses, as well as by the quantities of the minaral matter transferred by the Tisza and its tributaries.

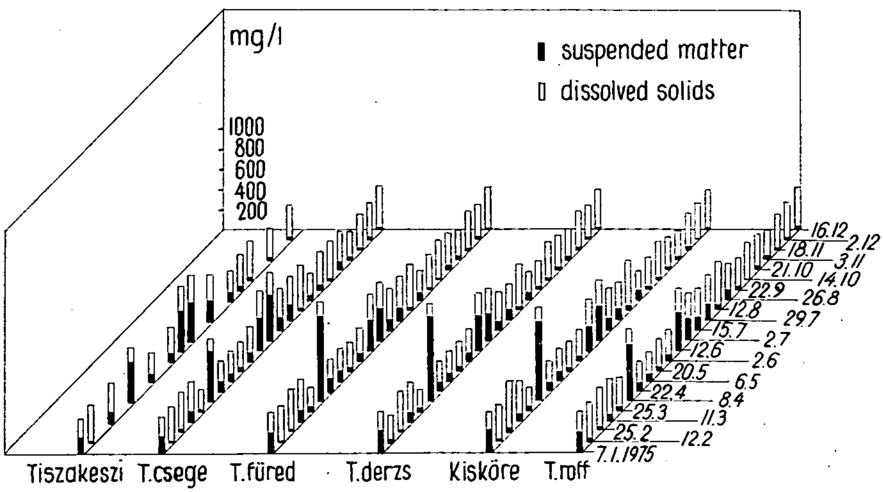

Fig. 1. Formation of suspended matter, dissolved matter, and dry matter content of the Tisza, in 1975.

At flood, the diluting effect of the water mass arriving prevailed; in cases like this, a considerable decrease in the concentration of kations and anions was observed. In a small-water period, the mineral-matter content of the Tisza-water has also risen, together with the increase in conductivity.

Picking out of the annual investigational series some time-points to be characterized with different water outputs, as well as the concentrations of kations and anions belonging to these, we have observed that the quantity of mineral matters flowing through the same section not considerably changed by the changes in the flow regimen — with the exception of hydrogen-carbonate.

It can be read from the Table below that the quantity of anions and kations in the traffic of materials is mostly independent of the water output, although their concentration increases or decreases in the proportion of the quantities transferred by the single tributaries.

Sampling date	Water ouput cc.m/sec	kations kg/sec							
		sodium		calcium		potassium		magnesium	
		A	B	A	B	A	B	A	B
March 11	537	15.0	15.0	32.5	32.5	1.3	1.3	6.1	6.1
April 8	1341	15.0	37.4	48.9	81.1	1.0	3.2	6.6	15.2
May 6	797	15.0	22.3	36.7	48.2	1.7	1.9	6.7	9.1

Sampling date	Water ouput cc.m/sec	Anions kg/sec					
		cloride		sulphate		hydrogenecarbonate	
		A	B	A	B	A	B
March 11	537	23.9	23.9	27.5	27.5	110.7	110.7
April 8	1341	20.3	59.7	34.8	68.7	260.5	276.5
May 6	797	16.6	35.5	17.2	40.8	140.5	164.3

A = the ion quantity flowing through the Kisköre section in a second;
B = the ion quantity that would have flown through the Kisköre section in a second if the diluting effect of the arriving water mass had not been present.

The formation of the sodium content is most striking: on March 11, 1975 at 573 cc.m/sec water output and 28.0 mg/l 15 kg, on April 8 at 1,341 cc.m/sec water output and 11.25 mg/l 15 kg, on May 6 at 797 cc.m/sec water output and 18.75 mg/l also 15 kg sodium ion streamed through the Kisköre section in a second.

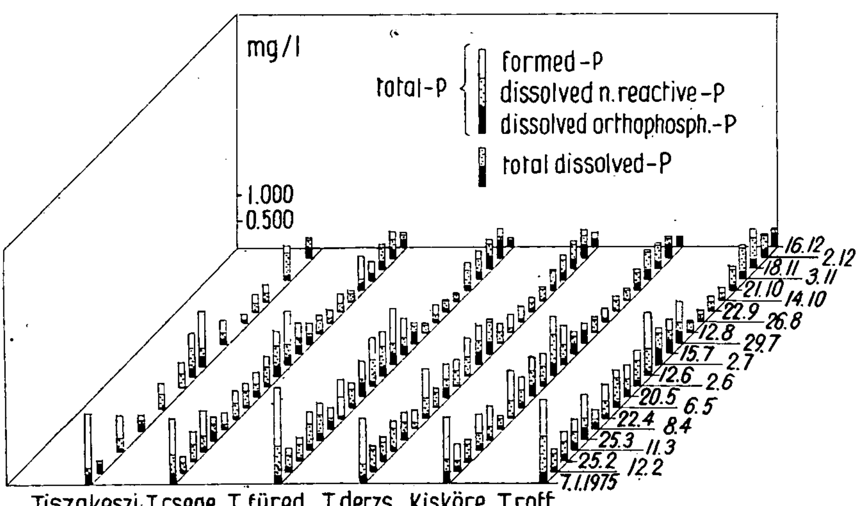

Fig. 2. Change in the quantity of phosphorus forms, in the investigated stretch of the Tisza, in 1975.

From among the anions, alone the quantity of hydrogen-carbonate has approached the calculated values. This can supposedly be explained with the regularities of the carbon dioxide-carbonate-hydrogencarbonate equilibrium system.

The plant nutritive matters which are important from the point of wiev of trophity and eutrophication — the various forms of phosphorus and nitrogen — are present in the Tisza water, which is the supplying water of the Kisköre Reservoir, in a considerable quantity. The extreme flow regimen and high suspended matter content is however, limiting the incorporation of the plant nutritive matters into the living organism. It is verified by the results of the investigations in the previous years, as well, that the nitrogen and phosphorus content of the different water-bodies flows away with the water mass, without any particular change. It was, however, made possible by the hydrological conditions changed as a result of the Kisköre damming — i. e., the considerable dropping of flowing speed, the silting of suspended matters, etc. — the formation of conditions which made the high plant nutritive matter content of the Tisza water already accessible to the autotroph organisms. (In the Autumn of 1973, we have observed an algal bloom of *Chlamydomonas*-type.)

This state was changed by the consecutive smaller and larger flood-waves, the high suspended matter content became a limiting factor again, owing to the returned river-water state, in the dammed Tisza reaches. Thus, in 1975, there was not observed any phenomenon like that in 1973, only some water colouration to a lesser extent.

It is easy to see on the basis of the results of the water-chemical investigations (Figs. 2—3) that may we take for basis any state of any flow regimen, the quantity of the inorganic plant nutritive matter in the water of the Tisza can never be considered as an inhibitive factor of photosynthesis (B. Tóth 1976).

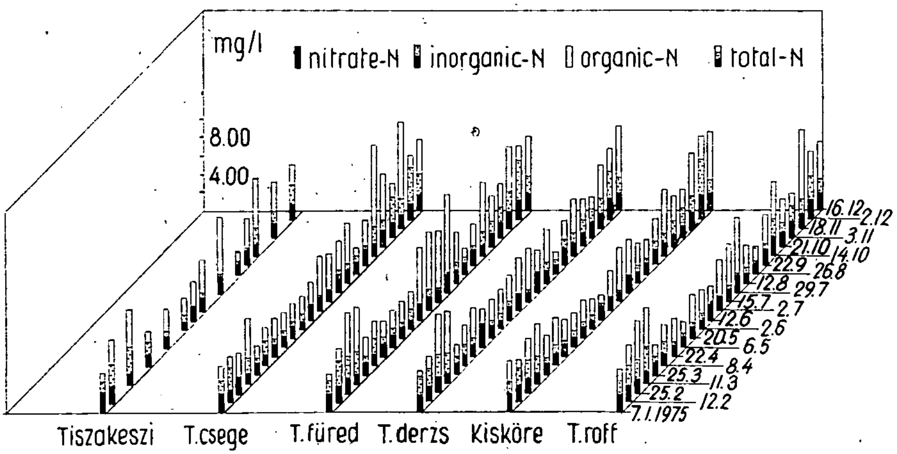

Fig. 3. Change in the quantity of nitrogen-forms, in the investigated stretch of the Tisza, in 1975.

It follows from this that in the Tisza the algal blooms characteristic of the eutrophic state can develop whenever the factors inhibiting the production cease, or are artificially ceased, to exist. The eutrophic state comes, therefore, into being most probably if in the warm period, as a result of riverbed-damming, the suspended matter content of the Tisza water is deposited, its translucense becomes stronger. This manifests itself, to a still greater extent, if an association of living beings of high species and individual number, developed as a result of the damming at Tiszalök, finds advantageous conditions in the district of the Kisköre river barrage.

In case of storing, the approachability of vegetable nutritive materials can take place very quickly if the conditions of standing water had developed and the suspended mater deposited. After filling it was finished, it seems advisable to avoid any intervention having an effect on the whole water mass of the reservoir. The use of the plant nutritive matters, as well as the disturbance of the stability, of the eco-system, already developed in the space of the reservoir, are to be prevented by an up-to-date water management. In order to avoid an early eutrophication of the Kisköre Reservoir, we should endeavour, therefore, that by harmonizing water management and the aims of the protection of water quality, the operation of the river barrage should serve at the same time for the manifold usefulness of the existing water-reserve.

Bacteriological investigations

The occurrence of *Planctomyces bekefii* GIM. is sporadic, their number varied between 6 and 120 thousand ind./l. The bacterial count in the Tisza fluctuated between 5 and 192 million ind./ml (0.88—34.5 mg/cc. m) (Fig. 4). Their value changed approximately together with the suspended matter (Fig. 5). It is to be seen in the Figure that the connection approaches the linear one but a considerable part of the points can be found in the lower value ranges (150 mg/l suspended matter and below 60 million ind/ml total bacterial count about its 90 per cent/. In case of damming, the bacterial count follows the change in suspended matter in the longitudinal section.

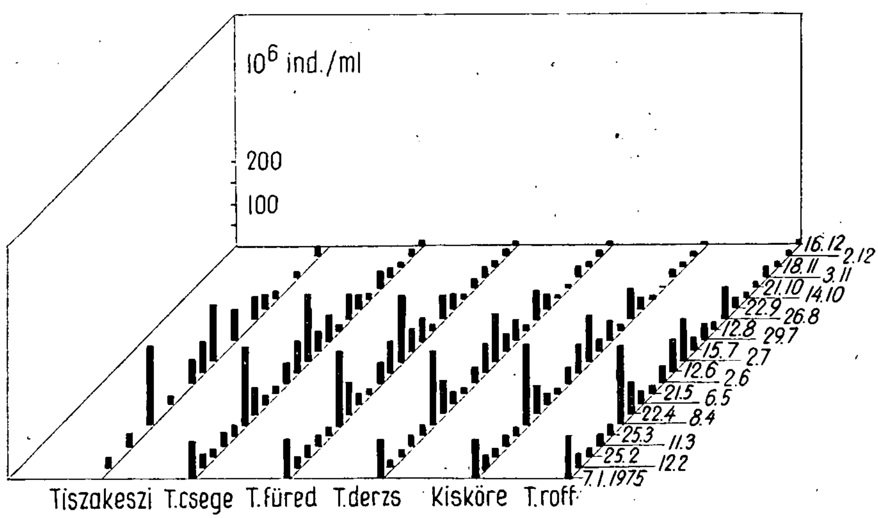

Fig. 4. Change in the total bacterial count in the investigated stretch of the Tisza, in 1975.

That is to say, the total bacterial count decreases as we approach the river barrage and after that it increases (HAMAR 1976).

On the basis of our estimate, in 1975 about 150 thousand ton bacteria passed the Tisza in the Kisköre section.

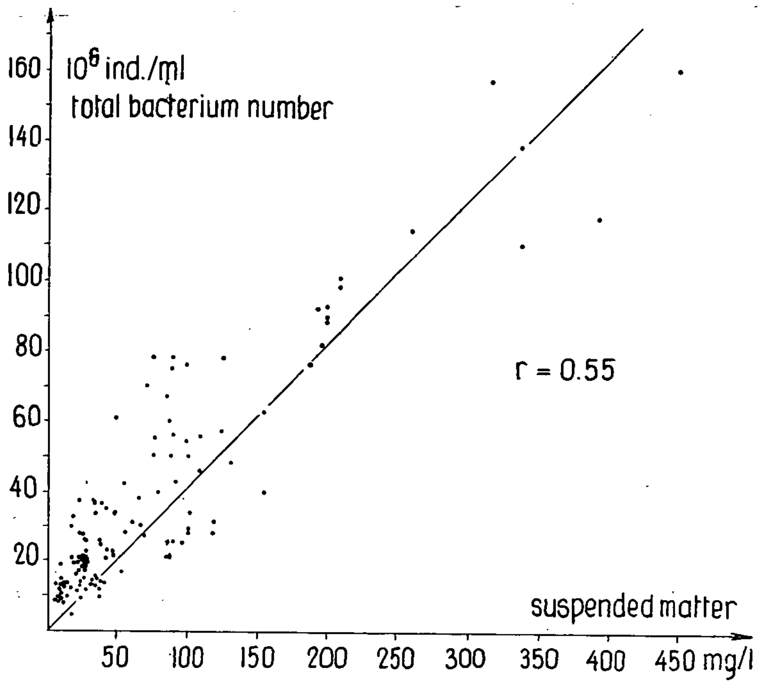

Fig. 5. Connection between the changes in the total bacterial count.

Algological investigations

In the course of the systematic algological investigations, performed between Tiszakeszi and Tiszaroff, 53 species, which are new for this stretch, were added to the list, as compared with the previous year. These are:

Anabaena affinis LEMM.
Anabaena spiroides KLEB.
Anabaenopsis raciborskii WOLOSZ.
Gomphosphaeria lacustris CHOD.
Lyngbya martensiana MENEGH.
Microcystis aeruginosa KÜTZ.
Oscillatoria granulata GARD.
Oscillatoria tenuis AG.
Phormidium molle (KÜTZ.) GOM.
Romeria leopoliensis (RACIB.) KOCZ.
Euglena oxyuris f. *minor* DEFL.
Euglena polymorpha DANG.
Trachelomonas hispida v. macropunctata SWIR.
Ceratium hirundinella (O. F. MÜLLER) SCHRANK.
Cyathomonas truncata (FRES.) FISCH.
Antophysa vegetans (O. F. MÜLLER) STEIN

Dinobryon sertularia EHR.
Heterochromas sociale (KENT.) LEMM.
Heterochromas vulgaris (CIEN.) PSER
Monas uniguttata SKUJA
Paraphysomonas vestita (STOKES) SAEDELEER
Amphora ovalis KÜTZ.
Hantzschia amphioxys (EHR.) GRÜN.
Melosira granulata (EHR. RALF.
Navicula cincta (EHR.) KÜTZ.
Navicula cryptocephala var. *intermedia* GRÜN.
Navicula cryptocephala var. *veneta* (KÜTZ.) GRÜN.
Navicula viridula KÜTZ.
Nitzschia linearis W. SMITH
Nitzschia longissima var. *reversa* GRÜN.
Navicula radiosa KÜTZ.
Nitzschia sigmoidea (EHR.) W. SMITH
Nitzscia sublinearis HUST.
Rhicosphaeria curvata (KÜTZ.) GRÜN.
Chodatella ciliata LEMM.
Coelastrum microporum NÄG.
Gonium pectorale MÜLLER
Lambertia gracilipes (LAMB.) KORSCHIK.
Pediastrum duplex MEYEN
Phacotus lenticularis EHR.
Scenedesmus armatus CHOD.
Scenedesmus denticulatus LAGERHEIM
Scenedesmus granulatus W. & W.
Scenedesmus intermedius CHOD.
Scenedesmus intermedius var. *bicaudatus* HORTOB.
Scnedesmus quadricauda var. *bicaudatus* HANGS.
Siderocystis fusca KORSCHIK.
Tetraedron trigonum (NÄG.) HANGS.
Tetraedron elegans PLAYT.
Tetrastrum staurogenieforme (SCHROED.) LEMM.
Closterium aciculare T. WEST.
Closterium acutum var. *variabile* (LEMN.) KRIEGER
Plactonema lauterborni SCHMIDLE.

In the investigated stretch, there wasn't observed any algal bloom. At the end of Summer — early in August, a blue-green alga, so far unknown in the Tisza: *Anabaenopsis raciborskii* WOLOSZ. was found, and similarly the *Anabaena affinis* LEMM., *Anabaena spiroides* KLEB., and *Microcystis aeruginosa* species, generally causing algal blooms.

It seems to us that the *Cryptomonas* species, belonging to the Pyrrophyta phylum (erosa, marssonii, platyuris, pusilla, ovata) become permanent in the dammed stretch.

From the living samples there turned up some colourless Flagellatae that could not stand being fixed ,some sorts of Monas and Heterochromas, as well as *Antophysa vegetans* (O. F. M.) STEIN and *Paraphysomonas vestita* (STOKES) SEAD. the occurrence of which indicates pollution (HAJDU 1975). It may be concluded from the systematic appearance of *Chrysococcus biporus* SKUJA and its large individual number in the time of dammings that this species is qualified as a eutrophic indicator.

The frequency of diatoms (Bacillariophyceae) is known, the newly-found species had a low individual number and were already known from the Tisza (UHERKOVICH 1971).

The result of the effect of damming is proved by the increase in the species number of green algae (Chlorophyta), as well.

The quantitative dynamism of algae was not at all so strong as in the previous years (ÁDÁMOSI et al. 1974, HAMAR 1976).

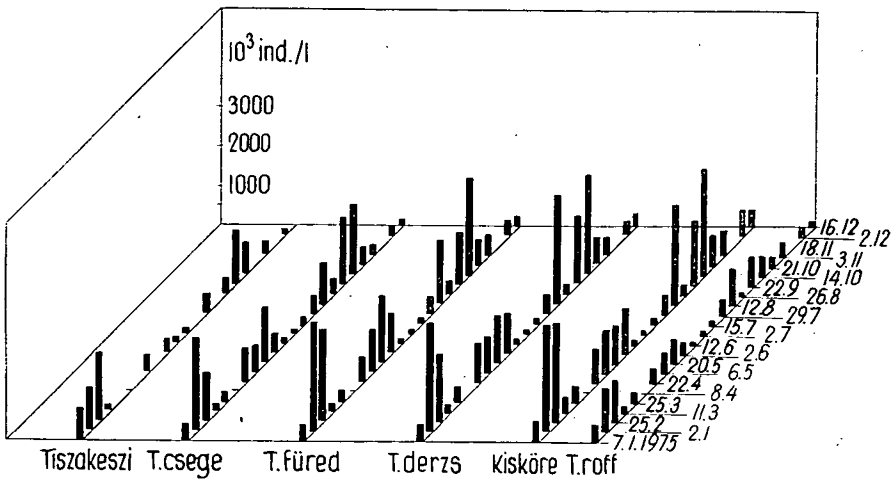

Fig. 6. Change in the total algal count in the investigated stretch of the Tisza, in 1975.

The cause of this may have been the lack of a lasting small water. There was a small water in the early Autumn and in Winter for a shorter or longer time. In the time of the winter small water, the individual number of the stock was surprizingly high (Fig. 6), being characterized by the multiplication of the diatom Stephanodiscus tenuis Hust. The temperature was 1 to 2.5 °C on February 12 and 25, but transparency — compared with that of the Tisza — is very high, 75 to 40 cm. The effect of damming could be demonstrated also in this case (Fig. 6).

The richness in species is characteristic of the early-autumn phytoplankton. Apart from the *Stephanodiscus tenuis* and *Nitzschia actinastroides* species, the green algae were dominating. In the time of floods, the total algal count was measured on April 30/30 thousand ind (1). The total algal count of the winter and late autumn dammings was very similar (about 3 million ind (1). In the time of dammings, the effect of damming increasing the total algal count was always verifiable.

As a result of damming, there appeared, in a systematic way, more and more species, not known in the Tisza so far, in the stretch investigated by us, showing the change in the character of the river. A part of these species refer to the increase in eutrophization (blue-green algae inducing algal bloom, *Chrysococcus biporus*, *Stephanodiscus tenuis*, etc.) while the colourless Flagellatae belonging to the family of Chrysophyseae *(Paraphysomonas vestita, Heterochromas socialis, H. vulgaris, Monas uniguttata, Anthophysa vegetans)* indicate an increase in the organic-matter content.

The values of chlorophyll content are very low, they could not be measured and were below 27 mg/cc.m. A conformity between chlorophyll content and total algal count is only in their tendency. Cf. Fig. 7.

On the basis of estimations, in 1975, in the Kisköre section, about 117 ton chlorophyll was passing.

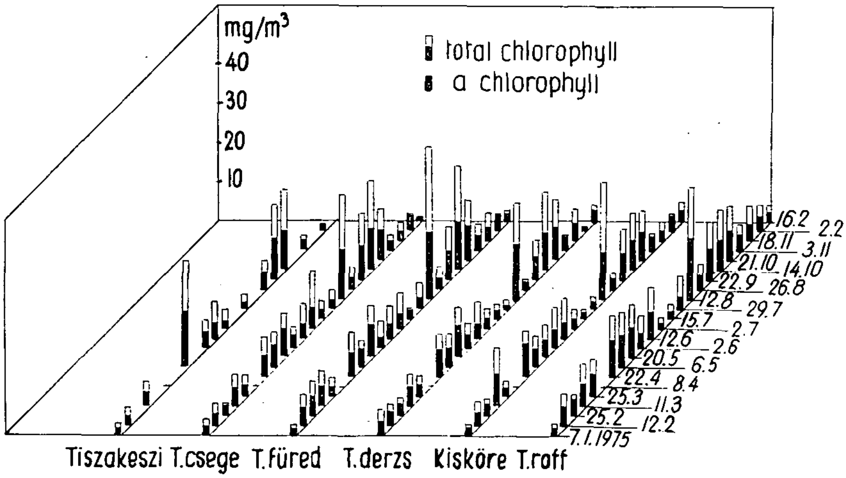

Fig. 7. Change in the chlorophyll content in the investigated stretch of the Tisza, in 1975.

Zooplankton investigations

In the course of the systematic investigations in 1975, we studied the Zooflagellata fauna. In the investigated river reaches, there were found the following species:

Bicoeca cylindrica (LACKEY) BOURR.
Bicoeca lacustris J. CLARK
Bicoeca planctonica KISS.
Bodo angustus (DUJ.) BLÜTSCHLI
Bodo ovatus (DUJ.) STEIN
Bodo variabilis (STOKES) LEMM.
Codonosiga botrytis (EHR.)
Codonosiga longipes STOKES
Pleuromonas jaculans PERTY
Rhynchomonas nasuta (STOKES) KLEBS
Salpingoeca bütschlii LEMM.

The majority of the enumerated species are organisms characteristic of a standing and somewhat polluted water. Their quantity is generally negligible.

The systematic investigations in 1975, in case of Rotatoria and Crustacea planktons, showed about the same picture as in the earlier years (ÁDÁMOSI et al. 1974, BANCSI 1975). Species composition and the density of individuals varied seasonably, as a result of the phenological rhythm and of the effect of the flow regimen of the Tisza (Fig. 8).

In addition to the species, found frequently enough in the year of the investigation, we have observed some organisms not known before. These are:

Dicranophorus caudatus (EHR.)
Euchlanis allata VORONKOV
Itura aurita (EHRB.)
Keratella quadrata var. *curvicornis* (EHRB.)

Euchlanis allata has got into the river from the watershed area of the Upper-Tisza region. Besides *Wolga spinifera* WESTERN, this species also survived, even if casually, but in the whole space above the Kisköre river barrage. Some species referring to pollution were found only casually (e. g., *Epiphanes senta* (O. F. MÜLLER)) .The characteristic species belong to *Brachionus, Filinia, Keratella, Polyarthra, Notholca, Rotatoria* genera.

From among Cladocera, in the same way as in the previous years (BANCSI 1976), *Bosmina longirostris* O. F. MÜLLER was the characteristic species of the investigated area. Individual density is, in the majority of cases, very low.

In the corse of investigating the Copepoda-plankton, there was found a *Calanoida* taxon, *Eudiaptomus gracilis* LILLJEBORG. The number of *Cyclopoida* species is higher; *Acanthocyclops vernalis* FISCHER, *Eucyclops serrulatus* FISCHER, as well as *Thermocyclops oithonoides* SARS can be considered as characteristic.

In the first quarter of the year (January-April) the medium species number and the low individual density are characteristic of the Rotatoria plankton. After the

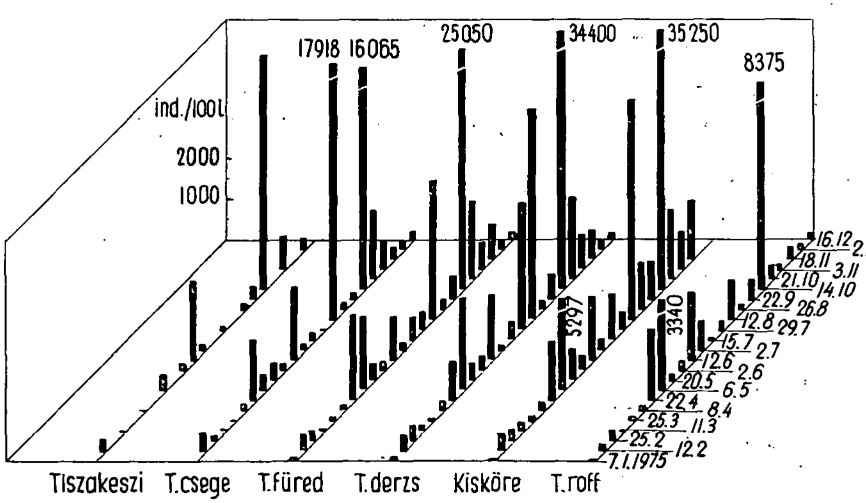

Fig. 8. Dynamics of the Rotatoria and Crustacea palnktons in the investigated stretch of the Tisza, in 1975.

flood of medium water output in January, in the cold water, there did not develop any fairly considerable Rotatoria stock, in February and March, either. The spring maximum appeared in the second half of April, and it could not be washed away even by the flood-wave. Thus in the period of its passing down, in the stretch between Tiszafüred—Kisköre, they were found in a considerable enough individual number. This must have been connected with the survival of the stock arriving in the water mass, recliding from the flood-plain, and developing there. Following this, until the middle of June, the species number of Rotatoria was again higher.

In the course of the year, the highest individual number was found on October 14, at the end of the small-water period, lasting from the second half of September until the middle of October. After this, in the dammed river stretch, the number of Rotatoria was for a while still high. Then, in the period of the end-of-year flood-wave, the Rotatoria plankton was again formed by species occurring in a scarce number.

The number of Cladocera species did generally not surpass a few hundreds per 100 litre. The subordinate role of Cladocera is characteristic of this year, too.

The very high individual density of the Copepoda-plankton in certain periods was the result of a considerable number of the forms being in copepodit and nauplius stage. The well enveloped individuals can only be found generally in a small number in the plankton of the Tisza.

The zooplankton of the Tisza has been determined by the flood-waves, damming, and the composition of the species-communities arriving together with the water receding from the flood-plain, this year, as well.

The floristic and faunistic investigations into the flood-plain water surfaces may bring us nearer to the understanding of peculiarities, seasonal changes of the river and, in this way, to revealing the hydroecological conditions of the Tisza.

The fundamental knowledge is anyway, necessary to elaborate the full picture

References

ÁDÁMOSI et. al. (1974): Duzzasztás hatása a Tisza vízminőségére a kiskörei vízlépcső térségében (Effect of damming on the quality of Tisza water, in the area of the Kisköre river barrage). — Hidrol. Közl. *12*, 570—576.

BANCSI, I. (1976): Zooplankton investigations in the dammed Tisza reaches. — Tiscia (Szeged) *11*.

FELFÖLDY, L. (1974): A biológiai vízminősítés (Biological water qualification). Vízügyi hidrobiológia 3., VÍZDOK, 1—242.

HAMAR, J. (1976): Data to the bacteriological and algological conditions of the region of Kisköre River Barrage. — Tiscia (Szeged) *11*.

HAJDÚ, L. (1975): *Paraphysomonas vestita* (STOKES) de SAEDLEER előfordulása hazánkban (Occurrence of *Paraphysomonas vestita* (STOKES) de SAEDLEER in this country).— Bot. Közl. *62*, 9—12.

B. TÓTH, M. (1976): Hydrochemical conditions of the river Tisza. 2. Seasonal dynamism of the oxygen household and nitrogen-phosphorus forms. — Tiscia (Szeged) *11*.

UHERKOVICS, G. (1971): A Tisza lebegő paránynövényei (The floating microplants of the Tisza). — Szolnok, 1—282.

VÉGVÁRI, P. (1976): Water motion in the Tisza and its connection with the suspended matter content. — Tiscia (Szeged) *11*.

VITUKI (1970): KGST Egységes Vízvizsgálati Módszerek (COMECON, Uniform Methods for Water Investigation). — Budapest.

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BENTHOS INVESTIGATIONS IN THE TISZA STRETCH BETWEEN TISZAFÜRED—KISKÖRE

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(Received August 15, 1977)

Abstract

He has continued the investigations begun in 1971 in the Dead Arm at Tiszafüred and in the Tisza between Tiszafüred and Kisköre. The conclusion is drawn from the change in zoobentos concerning the composition of the benthos developing in the reservoir. As a result of the impoundment started in 1973, in the reaches dammed the amount of Oligochaetae increased. In the investigated dead arm, on the other hand, Chironomidae predominate. As a large part of the vegetation in the flood-plain (undergrowth, shrubs) got under water-cover as organic materials, and the water-level slowly rises, thus in the resevoir the development of a rich zoobenthos is to be expected, under the dominance of Chironomidae.

Materials and Methods

For the quantitative and qualitative investigation of the benthos biomass we had to choose a date when the quantity of the Chironomida larvae could be measured in a comparatively real way, the development of imagos and the engorgement by various fish species also discontinue. The sprin months, because of different causes, are not considered to be suitable for this. Owing to the high water it is, namely, difficult to find the constantly water-covered part of the bed where the benthos-forming animals reside. The flood often leaves the area only at the end of June. And in this time, the spring-summer generation of the midge species already sent out its swarms.

Owing to the causes discussed, October was chosen for establishing the ratio of the individual numbers of Oligochaeta and Chironomida. Then the temperature of the river water is about +10 C. At a temperature like this, the zoobenthos is no more consumed by fishes, neither the larvae of the mud-dwelling Chironomida species develop into imagos.

At the right and left riversides, in different distances from the lines of these, we have taken ten samples on every occasion each. Our sampling sites were: the Dead Arm at the bathing-place of Tiszafüred and, in the Tisza, at Tiszafüred (428 river-km) and above Kisköre (406 river-km). Till 1975 we worked with a slime-gripper of 55.5 sq.cm and following this, with one of 78.5 sq.cm footing area.

Results

Of the Chironomida species, found in the river stretch investigated before damming, an account was given by Szitó (1973, 1974). On the basis of his investigations, the ratio of Chironomidae and Oligochaetae is shown in Figure 1.

In 1971—1972, the ratio of Oligochaetae and Chironomidae can be considered as constant. Already in the year of damming, 1973, the individual number of Oligochae tae increased in a Lmall degree. It is not likely that this increase was caused by damming. Their ratio increased in 1974 by 12, in 1975 by 1. while in 1976 by 24 per cent, taking the state of 1973 as 100 per cent.

In the Dead Arm, the dominance of Oligochaetae was expected. It is visible in the Figure that, contrary to the expectation, in 1970 the value of 23, in 1973 that of 47 and then, with some fluctuation, that of 30 to 40 per cent of the biomass was found. Both in the dead arm and in the Tisza (in the stretch investigated) a benthos biomass was examined consumed by the different animal species mainly by fish.

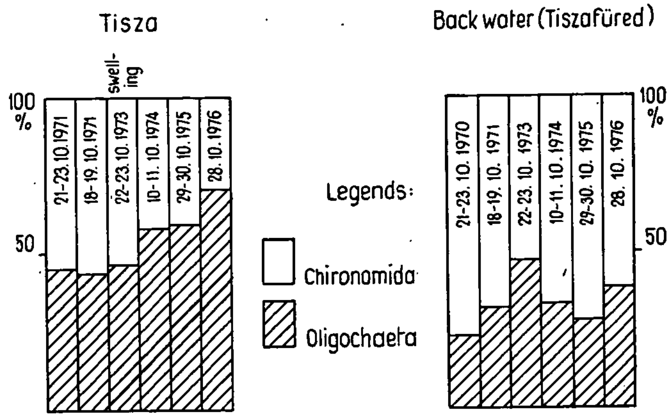

Fig. 1. Change in the ratio of Oligochaetae-Chironomidae (1970—1976).

Conclusions

The damming in the investigated stretch of the Tisza resulted in increasing the ratio of Oligochaetae. In this the slower water motion has certain part, ensuring better essential conditions to the present species than the earlier greater water speed did.

Among the Chironomidae, *Polypedilum nubeculosum* Mg. is dominant, *Chironomus fluviatilis* LENZ is subdominant.

In the Dead Arm, where 50 to 70 per cent of the biomass is formed by Chironomidae, the ratio of the biomass is quite different. Dominant is *Chironomus plumosus*.

The reservoir is shallow. In its areas of 30 to 40 cm water-cover and covered with sedge, submersed vegetation, in case of an adequate oxygen supply, a rich biomass may be expected.

References

SZITÓ, A. (1973): Data on the Chironomus fauna of the flood area of the Tisza at Tiszafüred-Kisköre. — Tiscia (Szeged) *8*, 43—45.

SZITÓ, A. (1974): Quantitative and qualitative study of Chironomida larvae on the section of the Tisza between Tiszafüred and Kisköre. — Tiscia (Szeged) *9*, 83—85.

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LIMNOLOGICAL INVESTIGATIONS IN THE LONGITUDINAL SECTION OF THE RIVER TISZA

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(Received September 30, 1977)

Abstract

For characterizing the limnological state of rivers, the longitudinal section investigations are suitable. The comprehensive evaluation carried out at different flow regimen (flood, low-water period) gives a reliable picture on the change in a passing water-body and its causes. The paper tries to give an overall picture of the river and of the natural and artifical effects touching that by analising the hydrological-phycisal-chemical-bacteriological-algological- and zoological investigations preformed on the Tisza (Central-Europe) in its flood and low-water periods.

On the basis of the hydrological characteristics, there were marked out two periods of different water outputs (flood, low-water). At measuring the longitudinal section, the flow-regimen of the Tisza and its tributaries was followed with attention. For getting an identical water-body, we have ascertained the medium velocity of water in more than one section. The measure of the natural and artificial effects exerted on the river is characterized by the distribution of velocity well.

In the time of flood, the bacterial content of the suspended matter coming from a runoff from land is very high (on the average 75×10^6 ind:/ml). In the time of low-water, with a low suspended matter content, the total bacterial number was $12—38\times10^6$ ind./ml.

There is a considerable difference between the algological composition of flood and that of low-water. In case of low-water, the dynamism of the alga community gives information for determining the different natural and artificial effects exerted on the river.

With the help of matter-current diagrams, the dynamics of the different parameters can be followed with attention in the longitudinal section of the river. The suspended matter content of water is considerable, so it influences the biological life of the river decisively. The results refer to that, in case of a low-water output, the eutrophication of the river is a real danger.

The Tisza has its own zooplankton stock, constituted by a strongly selected small proportion of the species to be found in the watershed area. The picture of the plankton changes as a result of dammings, the change in stretch-character, and the tributaries.

The half of the zoobenthos of the investigated Tisza stretch was Oligochaeta. The quantity of these showed downward tendency, going down the river. The dominant species is: *Limnodrilus hoffmeisteri* CLAPAREDE.

In respect of individual number, Chironomidae take the second place. Going down the river, the individual number shows an upward tendency.

The richest was, quantitatively, the zoobenthos in the Sajó, the poorest that in the Zagyva.

If we project the data of the Table on a square metre, we may establish that in the parts of the Tisza covered with a water of 0.5—3.5 m depth, in the 12 m broad riverside zone, there were found 180—900/sq.m Chironomida larvae. From this datum, only samples 11&12 differ strongly. The

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cause of the latter is that, after hatching out, the larvae of the same age, belonging to the same species, have remained together in large numbers, even in phases II and III. In the investigated river reaches, on the basis of our data, the average larval individual number may be put at 500—900/sq-m. Leaving out of consideration the data of samples 11—12, the investigated 162 km long river stretch may be considered as uniform by reason of the amount of larvae and the species forming the stock.

Introduction

For knowing a stretch of a river in details, it is fundamentally necessary to know the river as a whole. It is only possible to determine the results of natural and artificial effects if the basic state is also known.

In the earlier years, we studied the area under the influence of the Kisköre river barrage between river-kms 467 and 380 (ÁDÁMOSI et al. 1974, BANCSI 1975, HAMAR 1975, VÉGVÁRI et al. 1975).

In 1975, when the Tisza reaches in Hungary were investigated, we organized two longitudinal-section investigations, to know river more thoroughly.

There can be listed among the advantages of the longitudinal-section investigations that:

— in a given flow regimen situation it can practically follow with attention the change in a water-body;

— the effects of tributaries, major pollutions, dammings and the change in the stretch-character of the river can be demonstrated;

— the investigated parameters can be compared with one another unambiguously;

— on the way, some important observations can be carried out from the point of view of region conservation.

Its disadvantage is that it characterizes only a given flow regimen. It is shown by the investigations so far that it is advisable to perform the longitudinal-section investigations in two periods of different flow regimen for valuing the water-quality (ÁDÁMOSI et al. 1974, VÉGVÁRI 1975) — in the time of the early-summer "green" flood and at the late-summer low-water.

Materials and Methods

In 1975, we carried out our investigations into the Tisza on two occasions: the first investigation-series took place in a flood-period, between June 8 and 16, in the stretch between Tivadar and Szeged; and the second one in a low-water period, between September 18 and 27, in the stretch between Tokaj and Szeged (Fig. 1).

The sampling sites were chosen in a way that, partly, they should be adapted to the national sampling network; partly, on the basis of reliable bed-section surveys, to ensure the possibility of output calculations. We have taken our samples for the water-chemical, bacteriological, algological, and zooplankton, investigations from the following sites: Tivadar riv. km 718, Tiszaszalka riv. km 673, Záhony riv. km 638, above the Bodrog-mouth riv. km 551, below Tokaj riv. km 545, Tiszaladány riv. km 535, Tiszalök, upper, riv. km 524, Tiszadob riv. km 506, Gyulaháza riv. km 497, Polgár riv. km 486, Tiszakeszi riv. km 467, Tiszacsege riv. km 457, Tiszafüred riv. km 433, Tiszaderzs riv. km 415, Kisköre riv. km 404, Tiszaroff riv. km 380, Nagykörü riv. km 369, Szolnok riv. km 335, Tiszavárkony riv. km 320, Martfű riv. km 306, Tiszaug riv. km 266, Csongrád riv. km 245, Szentes riv. km 234, Mindszent riv. km 211, Ludvár riv. km 194, Tápé riv. km 177, Szeged riv. km 173, below Szeged riv. km 168.

The samples were taken from the current-line of the river.

The sampling sites of the zoobenthos investigations were at a distance of 3 to 12 m from the riverside, in places of 0.5—3.5 m water depth. The samples were taken from the Tisza above the inflow of the Sajó at riv. km 497, from the river Sajó, below the Sajó at Tiszapalkonya from the Tisza (riv. km 488), as well as at Tiszacsege (riv. km 457), at Tiszafüred (riv. km 433), at Kisköre

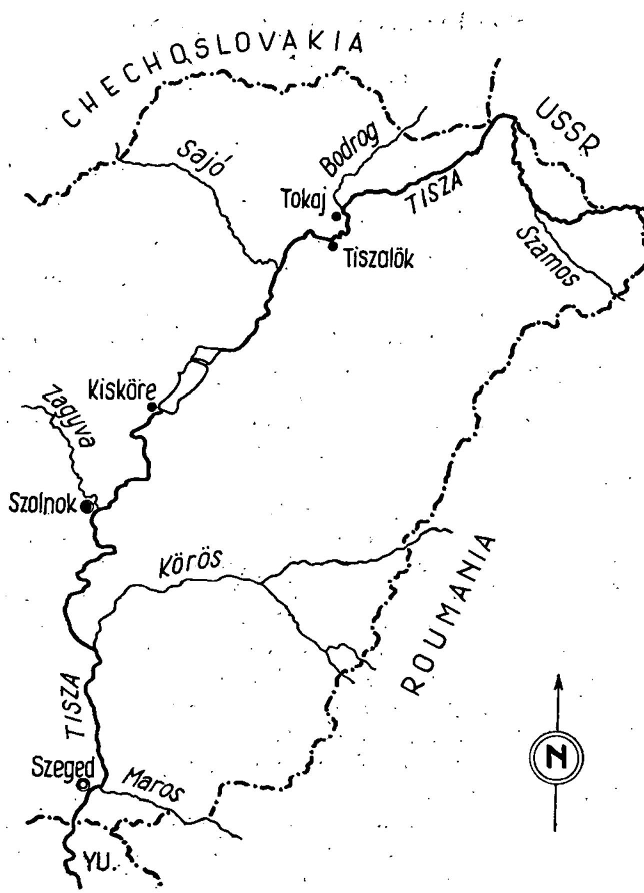

Fig. 1. Map of investigated area.

(riv. km 404), at Tiszaroff (riv. km 380), at Szolnok (riv. km 335), and at the mouth of the river Zagyva.

For water-chemical investigations we have taken a 5 l drawn sample. The measurings connected with the oxygen—carbon dioxide flow were carried out on the site. The determination of other components took place within 24 hours following sampling, at latest. The investigations were performed on the basis of COMECON: Uniform Methods of Water Investigation, as well as of FELFÖLDY's work (1974).

The water velocity was measured with a revolving water-velocity-meter (helix). The date of the next sampling was determined on the basis of the calculated values. This method made possible to follow the same water-body.

The 250 ml drawn samples, taken for quantitative algological investigations, were fixed with Lugol's solution. The elaboration was carried out with a inverted microscope.For the quantitative zooplankton investigations, in flood-periods 20 l, in low water periods 50 l water was filtered through a plankton-net of 25 IA quality (about 53). Samples were preserved with formalin. The investigation of zooflagellata took place from a living sample in the site. Deposition samples were taken out with a 425 mm long elutriating cylinder of 84 mm diameter, taking two samples from each collectingsite. Ins th e laboratory, from the matter washed through a 0.28 mm mesh metal sieve, under a cytoscope, the animals were selected by hand and preserved in 6 p. c. formalin.

HYDROLOGICAL RELATIONS

MARGIT ÁDÁMOSI

The Tisza, exposed to various natural and artificial effects, changes its hydro-ecological characteristics, that is to say, under similar hydrological conditions water-bodies of different properties pass down the river. It has therefore seemed necessary to perform the investigation of the longitudinal section of the river in a stretch attainable to us easily and for a characteristic period (flood, low water) each. In this case, the investigation of the longitudinal section meant that samplings took place from the water of the river, going together with water velocity.

The aim of investigating into the Tisza longitudinal section from June 8 to 16, 1975 was to accompany the passing of a hydrologically well-separable flood-wave. We had to chose a minor flood the water output of which did not achieve 1,000 cc.m/sec in the Kisköre section at culmination so that damming up the water should not be stopped either at Tiszalök or at Kisköre, and the effect of the river barrages should be measurable.

Another condition of realizing the investigation with success was to bring about a situation in which the water mass transferred by the more considerable tributaries was achieving or approximating the water mass of the Tisza in the given mouth-section of the river. The realization of this many-sided and complicated task must have been preceded by a comprehensive preparatory work concerning the water system of the whole Tisza and its tributaries. We had, therefore, at any rate to wait till the spring-flood, being generally connected with a large water output, was over.

On June 8, 175, after the spring-flood was over, the hydrological situation appeared favourable for starting the expedition. Parallel with the flood beginning in the Upper-Tisza on June 3, the formation of the flood-wave began in the Szamos, Bodrog, Kőrös, and Maros. The Tisza flood culminated on June 8, at Tivadar, with 211 cc.m/sec, the flood-wave of the Szamos reached the mouth on June 8, with a water output of 181 cc.m/sec. After the confluence of the Tisza and Szamos, the flood-wave got to Tokaj on June 10, where the water amount was increased by the Bodrog with a 105 cc.m/sec water output. The Sajó connected itself to the Tisza flood-wave with 40 cc.m/sec water output on June 11, the Zagyva with 10 cc.m/sec on June 14, the Hármas Kőrös with 122 cc.m/sec on June 15, and the Maros with 730 cc.m/sec water output on June 16. The flood of 211 cc.m/sec water output at Tivadar, as a result of the water amount carried by the tributaries, left the country border at Szeged, on June 16, risen to 1,662 cc.m/sec.

Together with the passing of flood-wave, the values of water level, water output, water velocity and the fall of water surface go on changing. First the increase in the fall of the water level begins and is more and more intensive. A greater fall is connected with a greater velocity. The approach of the flood-wave, the increase in the fall of water surface are followed by an increase in velocity, without inducing any change in the local water surface. This means that at an unchanged flowing through the section, due to a greater velocity, more water is streaming through the section in the time unit than before the flood-wave was approaching. *I. e.,* the water output increases. This phenomenon is called inner storage. By reason of the above-mentioned law of storage, the velocity and simultaneously the water output decrease. This process manifests itself in rising the water level.

The formation of flood-waves is shown by the water levels in June. The above-mentioned flattening-out may be observed well already 100 river-km below. In the time of the flood-wave in June, damming was not ceased either by the Tiszalök barrage or the Kisköre barrage. There could not develop, therefore, any natural situation in the Tisza.

The flood-waves in the dammed river stretches flatten out entirely. The more flattened flood-wave can be observed in the water outputs coming through.

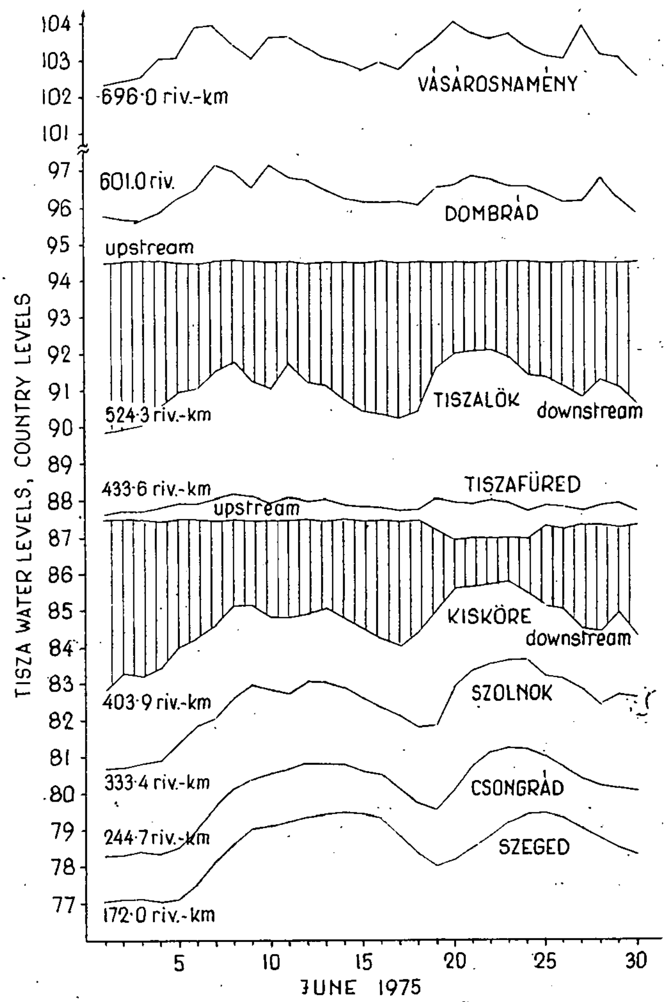

Fig. 2. Cf. the text.

The flooding secondary flows are reproduced well by the water-levels at Szolnok, Csongrád, Szeged. The flood-waves are drawn out long in the time, their height does, however, not change, they do not flatten out (Fig. 2).

In the pre-established sections of the Tisza and tributaries the water samples were taken after measuring the velocity of water flow, at dates calculated on the basis of the river-kilometres. The date of water sampling in the following section will be determined on the basis of registering the velocity data coming from the ship and the passing time of the flood wave. This method enabled us to follow the water-body along the whole Tisza stretch in Hungary.

In the course of the investigation it turned out, as well, that at floods, in case of the given water-body, as a result of the flood-waves in the tributaries, a difference may follow even in the character of the change in water. Up to Vásárosnamény, the investigated water-body coincided with the culmination of the flood. On the other hand, the flood-wave arriving from the Szamos was connected with that of the Tisza in a way that the water-body, followed closely after being united, has got into the ascending arm of the modified flood-wave. The greatest difficulty appeared in the dammed reaches before both river barrages. The water transmitting system of the barrages differs from the natural flowing conditions in the Tisza. Therefore, the position of the given water-body was to be followed with attention to a greater extent. On the basis of the data of the water output let through the river barrages and of the values of the flowing velocity was determined that the water-body investigated has got at Tiszalök into the middle of the ascending arm of flood-wave and to its upper one-third at Kisköre. This ascending arm was followed up to the Zagyva mouth. The water mass of the Tisza was not influenced by the unimportant water output of the Zagyva. Thus, we have got under similar hydrological conditions to the mouth section of the Hármas-Kőrös. Here we met the ascending arm of the flood-wave in the Hármas-Kőrös what has not modified, either, the character of water change. Below Tápé, the descending arm of the flood in Maros has arrived at the water mass investigated. In this way, the water body followed from the mouth down to the frontier of the country took place in the first one-third of the ascending arm of the modified flood-wave.

In the time of the longitudinal section investigation, as a result of the water mass of the tributaries, the water output of the investigated water-body was modified as follows. The 211cc.m/sec water output above the Szamos arose to 392 cc.m/sec after the mouth, below the Bodrog to 585 cc.m/sec, below the Sajó to 711cc.m/sec. At the date of sampling, at Kisköre 678 cc.m/sec water output was measured. Above the Zagyva 800 cc.m/sec, below its mouth 810 cc.m/sec, below the Kőrös 932 cc.m/sec and below the Maros 1,662 cc.m/sec was the output.

The aim of investigating the longitudinal section from 18 September till 27 September was to analyse the changes taking place in the Tisza stretch in Hungary during a low-water period, with particular regard to the effects of the character of the river stretch and the effects of dammings and tributaries. For this task, there were to be awaited some conditions under which neither the Tisza nor its tributaries flooded.

For the faourable occasion we had to wait until September 9th, 1975. Then flood was announced from the Upper Tisza, the lesser flood-waves of the tributaries were already culminating. This meant recession from this direction, too. The investigation began from Tivadar, on September 9. On September 10, the flood-wave coming from the Szamos with 178 ss.m/sec and a quick downflow overtook the investigated water-body and, after being mixed with that, produced such a situation that further on it did not seem to be practical to continue the investigation. We had to wait till the flood-wave was over, and the expedition began again from the section above the inflow of the Bodrog, on September 18.

Then the investigation could already be continued undisturbedly. A typical „low-water period" came about at the Tisza and its tributaries. On September 18, the Tisza with 242 cc.m/sec water output was joined by the Bodrog with 50 cc.m/sec output. At the dates of the investigation, in the Sajó 22 cc.m/sec, in the Zagyva 13 cc.m/sec, in the Hármas-Kőrös 78 cc.m/sec and in the Maros 108 cc.m/sec water outputs were measured. The water output of the Tisza was at Tiszalök 238 cc.m/sec, at Szolnok, on September 24, 266 cc.m/sec, at Csongrád, on September 26, 381 cc.m/sec, at Szeged, on September 27 550 cc.m/sec.

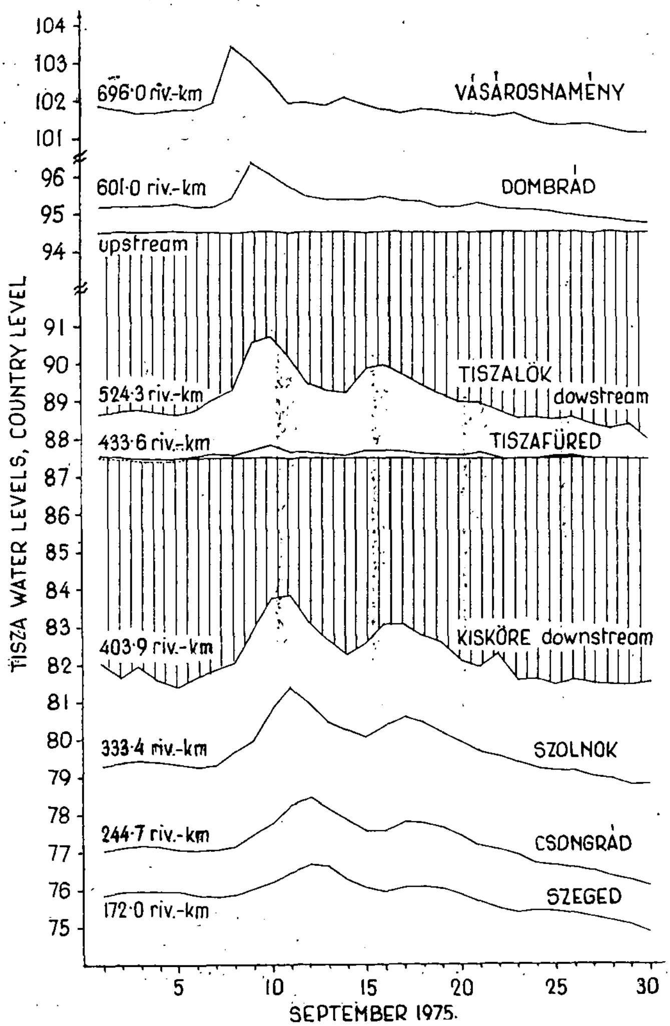

Fig. 3. Cf. the text.

The low-water period is shown by the Tisza water-levels well. It is also indicated by the so-called high "river barrages" formed out in the damming plants that the arriving and transmitted water output was little, inducing the necessary sinking of the downstream level. At the date of measuring, there has not arrived any flood-wave in the secondary flowings. Thus the effect of the earlier flood-wave, induced by the Szamos, could be demonstrated (Fig. 3).

The effects of various forces are exerted on any water mass, thus on the Tisza, as well. The water motion takes primarily place as a result of the force of gravity. In the course of motion also appears the so-called Coriolis acceleration. This is nothing else than a deflecting force, produced by the rotation of the Earth. In case of the Tisza, this force is directed towards the right riverside, there its effect on the bank is destructive. In some cases, the centrifugal force is also effective. All the three forces are influenced by the depth of water. By these forces, the velocity relations of the natural waterflow are also influenced. This manifests itself first of all in the deviations of the direction. The fluctuation of the direction of velocity, its pulsation are namely not only perpendicular but they are also effective towards the riversides, in horizontal sense, depending on the strength of the frictional force. There were also

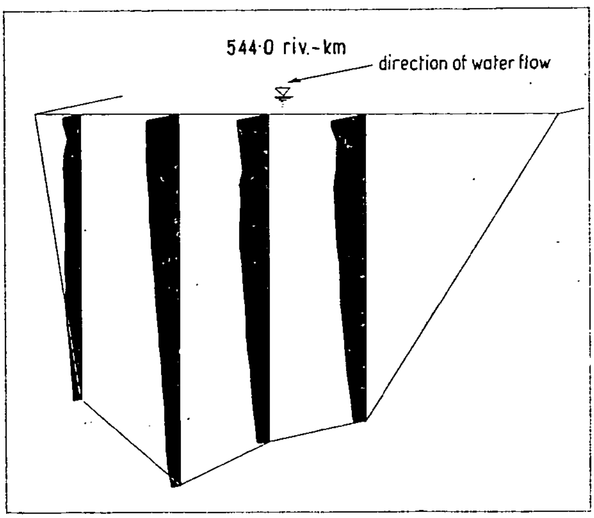

Fig. 4. Cf. the text.

investigated the distribution, extent of the velocity in the direction of advancement, according to water depth. It can be observed on the basis of the measured data that the distributions of velocity diminish as we approach the bottom. The maximum value in a vertical section is achieved in about 0.2 H distance below the water surface, where H = water depth. Their shape may generally approached by a parabola. Longitudinal speeds also change according to whether they were measured in a dammed section or in the natural stretch.

In the dammed sections, smaller velocity take generally shape but with a steadier distribution. At river-km 544, the average velocity of the section is 1.21 km/hrs (Fig. 4). The greater velocity fall to the upper one-third of the cross-section. This can be explained with the water release of the river barrage at Tiszalök where, by means of bed-damming, 94.50 m A. O. D. damming level is held. The arriving water output is released by means of upper overflow, reaching the release of the corresponding water output by rising or sinking a wicket. But at the time of producing energy, the water mass is transmitted through the turbines. The distribution of velocity at river-km 467.9 is no more showing the same picture as the former one was, although this is a dammed section, as well. The section measured was here not 20 but 70 km above the river barrage, about halfway down from Tiszalök to Kisköre. Although the effect of the Kisköre damming is observable up to Tiszalök, nevertheless, the

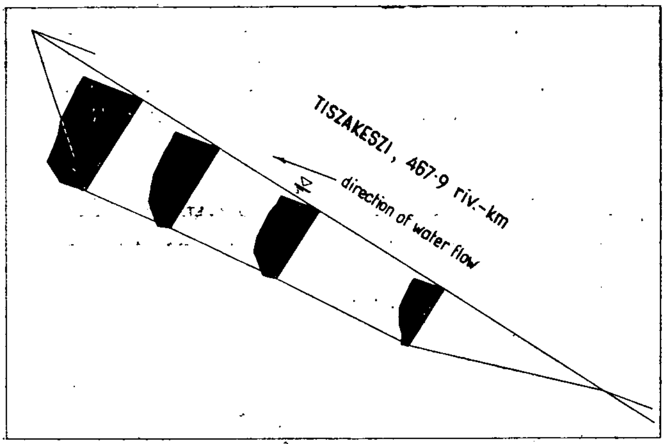

Fig. 5. Cf. the text.

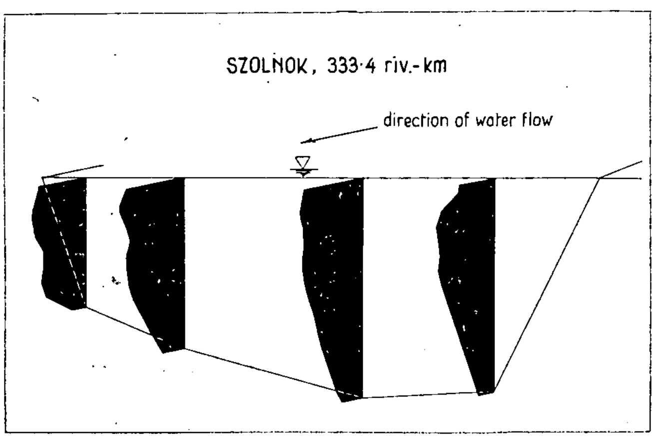

Fig. 6. Cf. the text.

distribution measured here approaches the basis of the distribution of velocities, measured in a natural state. The average-velocity value of the section is 1.94 km/hrs. This value continually decreases as the water approaches the damming plant (Fig. 5).

The operation of the Kisköre river barrage is different from that of the Tiszalök damming-plant. The water column is held by a so-called tainter (segmental) gate by lifting of which a lower water-weeping takes place, at 87.50 A. O. D. damming level. The water output, determined by calculation, is transmitted by rising, sinking the tainter gate, as well as at time of energy production, after placing the gates on the raised sill, through the tube-turbines. The other speed measurings took place in the natural stretch of the Tisza (Fig. 6).

The value of the medium velocities is 2.21 km/hrs and 2.28 km/hrs. In the different vertical sections of the bed the velocities are proportionate what means that the bed is in equilibrium. Velocity measurings were carried out at every sampling site. The date of arriving at the next section was determined in this way.

At the later supervision it turned out that the investigation was performed at the beginning of the smallest water-output period of the Tisza.

PHYSICAL AND CHEMICAL CONDITIONS IN THE LONGITUDINAL SECTION OF THE RIVER TISZA

P. VÉGVÁRI

The physical and chemical results obtained in the course of the longitudinal-section investigation performed in the Tisza in 1975, on two occasions — in the flood- and low-water periods — were showing obvious differences.

In the flood-period, the free carbon dioxide concentration of the Tisza water, its suspended matter content and output, from among the suspended matter-depending components the total iron and total phosphorus content and output, the total nitrogen and total dissolved-matter output, as well as its chemical oxygen needs measured with acid potassium permanganate and potassium dichromate were considerably higher; on the other hand, its total nitrogen content, transparency and pH were lower than in the low-water period.

The (dissolved oxygen content and oxygen saturation of the investigated water-body gradually decreased in the longitudinal section in the time of flood, and increased in the low-water period.

At investigating the plant nutrients which are important from the point of view of eutrophication, it was established that — whatever flow regimen we take as our starting-point — the quantity of the phosphorus and nitrogen in the Tisza water cannot be considered as an inhibiting factor of photosynthesis (primary production).

In the Tisza stretch in Hungary, in 1975, on two occasions — following some characteristic water-bodies — we investigated into the physical and chemical changes in the Tisza water.

At dealing with the hydrological conditions according to some determined points of view (ÁDÁMOSI, M. 1977) on June 8 to 16, in the river stretch between Tivadar (river km 718) and Szeged (river km 168), we followed with attention a floodless, so-called low-water period.

In practice, the use of the concentration of matters which are present in the water in dissolved or suspended form, *i. e.,* of the values of the various components being in 1 litre or 1 cubic metre of water, expressed in millimetres (mg/1; mg/c • m) became general. These values apply, however, only to the unit of the valume of water, leaving out of consideration the quantity of water and the river-water character.

In hydrology it is already natural that the water mass of a river is characterized by the water output, that is by the water quantity flowing through a determined section in a second. At evaluating some results of the longitudinal-section investigation, it seemed to be advisable to take into consideration, apart from concentration, the matter output, as well, which is also reflecting water quantity and the river-water character (T. DVIHALLY, ZS. 1963, DVIHALLY ZS.&VÁGÁS 1966, VÁGÁS 1963).

The output of a dissolved or suspended component (matter-output: M kg/s) can be obtained if the value of the component concentration measured in a given section (C kg/c.m) is multiplied by the water-output belonging to it (Q cubic m/s).

The matter-output — depending upon to which of the investigated components it applies — was designated with the names suspended-matter-output, sodium-output, chloride-output, etc.

Results of the investigations into the flood-period

Physical conditions

Water temperature varied during the investigation time of the longitudinal selection between 15.2 and 21.4 °C. Its mean temperature was 17.3 °C. In accordance with the early-summer weather, the day-time maxima were 2 p.c.higher than the minima of the small hours.

It was observed that in the longitudinal section the investigated water-body got gradually warmer, and the temperature values measured in identical hours below Szeged (river km 168) were higher by 5—6 °C than those measured in the upper Tisza regions.

The water which was transparent, of greenish colour until the mouth of the Szamos, has changed yellowish-yellowisch-brown after the inflow of the Szamos and this colour has remained characteristic, further on, of the investigated water-body.

The Szamos exerted the greatest effect on the transparency of the Tisza water, as well. The comparatively high transparency (55 cm) measured in the section at Tivadar (riv.km, 718) quickly decreased below the mouth of the Szamos and had a permanent value (10 cm) till the inflow of the Bodrog. The tranparency of the water-body did not change considerably from the mouth of Bodrog until that of the Kőrös. It was 9 to 11 cm, depending on the water velocity and the quantity of suspended matter. Because of the diluting effect of the Kőrös, there were measured higher values (12—14 cm) until the mouth of the Maros. By the 5 cm transparency of the rising Maros, the transparency of the Tisza water was decreased to 8.5 cm.

In the investigated period, the Tisza was arriving at the section at Tivadar (riv.km 718) with a comparatively low suspended matter concentration (30 mg/l) and output (63 kg/s). The quantity of the suspended alluvial matter of the river was considerably raised by the flooding Szamos — the suspended matter content of which was 1273.4 mg/l, the output 230.48 kg/s — and there were measured high valued (540—468 mg/l, resp. 211.7—183.5 kg/s) down to the mouth of Bodrog. The diluting effect of the Bodrog could be observed well in the sampling section (riv.km 545) below Tokaj. It was proved by the gradually rising concentration- and output-values, measured after the inflow of the Bodrog, that a rather long way (about 8 to 10 km) was necessary to mix the Bodrog water.

In the immediate range of the river barrages (between 535 and 364 riv.km), in this period, the suspended, -matter conditions of the investigated water-body was primarily determined by the operation of the river barrages (BOGÁRDI 1971). The flood-wave of precipitous course was let through by the river barrage at Tiszalök in a way that the water velocity, and with that the power preserving the drift-matter in floating, increased. As a result of this, we have measured at Tiszalök (river km 524) 378.6 mg/l, resp. 254 kg/s, and at Gyulaháza (479 riv.km 497) 463.2 mg/l, resp. 310.8 kg/s values.

Below the mouth of the Sajó "221.4 mg/l; 8.8 kg/s), the suspended matter concentration of the water of the Tisza decreased by 12.6 mg/l, its outlet, however, increased by 9.6 kg/s. In the sampling section at Polgár (riv.km 486) we have obtained a value of 450.6 mg/l, resp. 320.4 kg/s.

From Polgár on (riv.km 486), the damming effect of the Kisköre river barrage already prevailed and, with the gradually decreasing speed of flow, the suspended

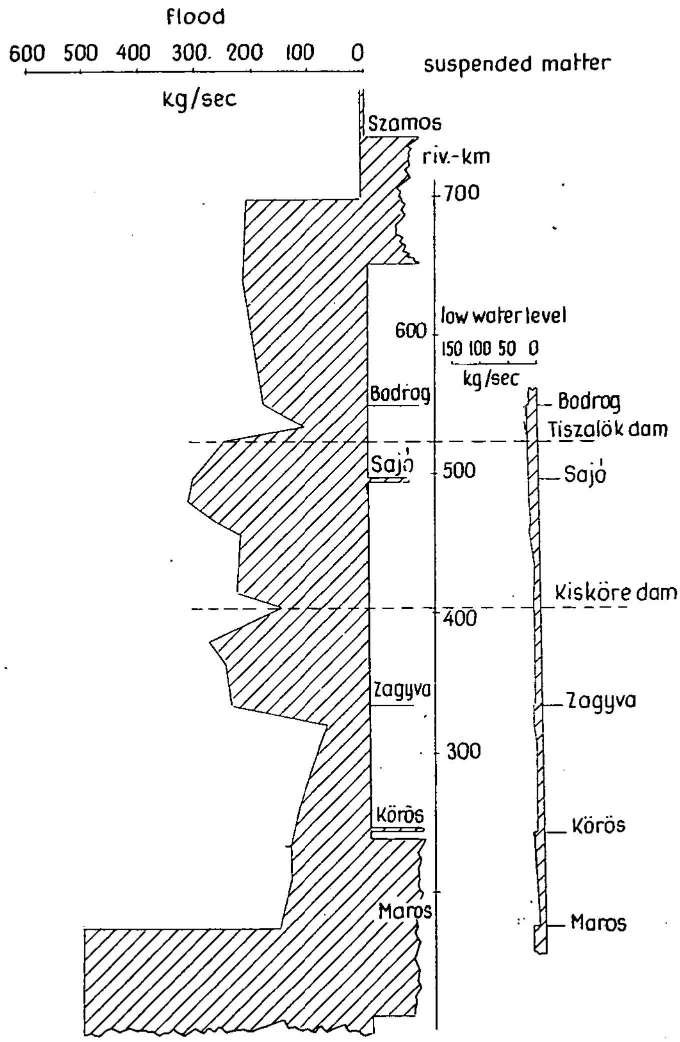

Fig. 7. Formation of the output of the suspended matter in the longitudinal section of the Tisza.

drift of the water also began depositing. In the section above the river barrage (riv.km 404), the suspended matter content of the investigated water-body was 232.2 mg/l and its output 157.4 kg/s. A smaller flood-wave — of a water output below 1000 cubic m/s — was let through by the Kisköre River Barrage in a way that damming was not terminated thoroughly. In a case like this, in the low-water side of the river barrage, the water speed is always higher than on the headwater side. Below the river barrage, the flowing velocity of the water getting outside increase-d again. With its superfluous energy it took along with itself and preserved in floating a newer quantity of the bed-matter. In the sampling section at Tiszaroff (riv.km 380), its concentration increased to 361.2 mg/l, and its output reached 289.0 kg/s.

Approaching the lower Tisza region, the water speed and the amount of suspended matter decreased — in accordance with the character of the stretch. — At Tiszavárkony (riv.km 320) — taking also into consideration the diluting effect of the Zagyva — we have obtained the values 96.4 mg/l, resp. 78.1 kg/s. At Csongrád (riv. km 245), above the inflow of the Kőrös, the values 204.4 mg/l, resp. 165.5 kg/s were obtained. The Kőrös (47.6 mg/l; resp. 5.8 kg/s) brought about — similarly to the Sajó — a decrease in the suspended matter concentration of the Tisza and a minor increase in its output.

The flooding Maros again brought a considerable quantity of suspended matter into the Tisza (436.2 mg/l; 318.4 kg/s). As a result of this, the Tisza water left the frontier of the country with a suspended matter content of 313.6 mg/l and an output of 5251.2 kg/s (Fig. 7).

Water-chemical conditions

The iron content of the water of the Tisza is of mineral origin. Its quantity changes — as a result of the geochemical character of the watershed area of the Tisza and its tributaries — in a close connection with the suspended matter content (KATONA 1976). This establishment was unambiguously proved by the investigation into the longitudinal section carried out in the flood-period.

The Tisza arrived at the sampling section at Tivadar (riv. km 718) with a total iron content (1.61 mg/l) and output (0.34 kg/s) that was similar to those experienced in case of the floating matter. The iron content of the Tisza was increased by the flooding Szamos (68.27 mg/l; 12.35 kg/s) to 30-times as much as the initial concentration (48.16 mg/l) and its output to a velue 55-times as high as the initial value was (18.88 kg/s).

The total iron content was formed by the single tributaries — the Bodrog (1.41 mg/l; 0.15 kg/s), the Sajó (15.47 mg/l; 0.62 kg/s), and the Zagyva (1.29 mg/l; 0.013 kg/s) — as well as by the river barrages in the same way as the suspended content. Thus there were measured the following values: at Tiszalök (river km 524) 11.43 mg/l, resp. 7.67 kg/s; at Gyulaháza (riv.km 497) 15.09 mg/l; resp. 10.12 kg/s; at Kisköre (riv.km 404) 6.09 mg/l; resp. 4.13 kg/s; at Tiszaroff (riv.km 380) 9.75 mg/l; resp. 7.8 kg/s; at Csongrád (riv.km 245) 11.58 mg/l; resp. 9.4 kg/s. After the inflow of the Kőrös (2.71 mg/l; 0.33 kg/s), there was observed a considerable decrease in the total-iron content and output. As a result of the flooding Maros (13.77 mg/l; 10.05 kg/s), the totaliron concentration rose to 10.29 mg/l. And with its 17.1 kg/s output it approached the values measured below the Szamos (riv. km 673) (Fig. 8).

The pH of the investigated water-body did not change considerably in the longitudinal section. The values obtained were in 70.8 per cent of samples 7.1—7.2;

and in 20.9 per cent 7.3—7.4. At Záhony (riv.km 638) we have measured pH 7.65 and at Tiszaderzs (riv.km 415) 6.9.

Owing to the high suspended matter content, the production of the photosynthetic oxygen of the investigated water-body was negligible. Correspondingly, the dissolved oxygen content was determined by the atmospherical oxygen getting into the course of the movement of water and by the change in water temperature. The dissolved oxygen content of the Tisza water varied between 9.6 and 6.48 mg/l, its mean value being 7.9 mg/l. The values measured in the day-time — corresponding to the higher temperature of the water surface — were by 0.5 to 0.6 mg/l lower than those in the small hours.
In the longitudinal section — apart from the gradual warming up of the investigated water-body — there was observed — a decrease in the concentration of dissolved oxygen, as well. In the sampling section a Szeged, there were measured concentrations less by 2.0—2.5 mg/l than the initial values (*e. g.*, at Záhony (river km 638), at 13.20,8.88 mg/l, while in Szeged (riv. km 173), at 11.30, 6.48 mg/l). The oxygen saturation of the water has never reached 100 per cent in the course of the investigation.

There predominated in the Upper-Tisza Region between Tivadar (river km 718) and Záhony (riv. km 638) high values of 96—90 per cent, in the Middle-Tisza stretch between Tokaj (riv. km 545) and Csongrád (riv. km 245) medium values of 85—80 per cent, in the Lower Tisza Region between Szentes (riv. km 234) and the frontier of the country lower values of 75—74 per cent. That is to say, in the longitudinal section the oxygen saturation has also decreased.

The Tisza — its predominating kation being calcium — belongs to the group of the so-called waters of positive carbon-dioxide content. Its carbon-dioxide content makes rapid progress together with the calcium-ion concentration. The water can, therefore, store even 60 to 70 times as much carbon dioxide as 0.37 mg/l which is in state of equilibrium with the partial pressure of the carbon dioxide content of the air (FELFÖLDY 1969).

The free carbon-dioxide content of the investigated water-body was determined — apart from pH and temperature — primarily by the concentration of calcium, magnesium, and hydrogen-carbonate. Its values are very high —, what is characteristic of the flooding Tisza — in 79.2 per cent of the samples we have got quantities between 8.0 and 12.0 mg/l. The lowest concentration — 5.64 mg/l — was measured at Tivadar (river km 718), the highest one — 13.73 mg/l — at Tiszakeszi (riv. km 476) and Tiszaug (riv. km 266).

The chemical demand of the Tisza, measured with acid potassium permanganate and potassium dichromate (hereinafter called: COD aMn, resp. COD Chr), was characterized by low values up to the mouth of the Szamos (at Tivadar [river km 718] 2.49 mg/l; 8.41 mg/l). As a result of the high organic-matter and iron content, transported by the Szamos, the COD aMn and COD Chr of the Tisza water rose considerably. Thus, until the inflow of the Bodrog, we have measured 5—6-times as much as the initial values (15.65 mg/l; 13.18 mg/l), resp. 3—4-times as much (36.17 mg/l; 28.70 mg/l). In this river stretch, 25 to 50 per cent of the COD aMn and 20 per cent of the COD Chr quantities were reached by the oxygen requirement of the iron content of water (6.74 mg/l; 3.31 mg/l). Between the mouths of the Bodrog and Sajó the values were reduced. At Gyulaháza (river km 497) the chemical oxygen requirement of water was 6.96 mg/l, resp. 22.08 mg/l, a still considerable proportion of which (30 per cent, resp. 10 per cent) was given by the oxygen requirement of the

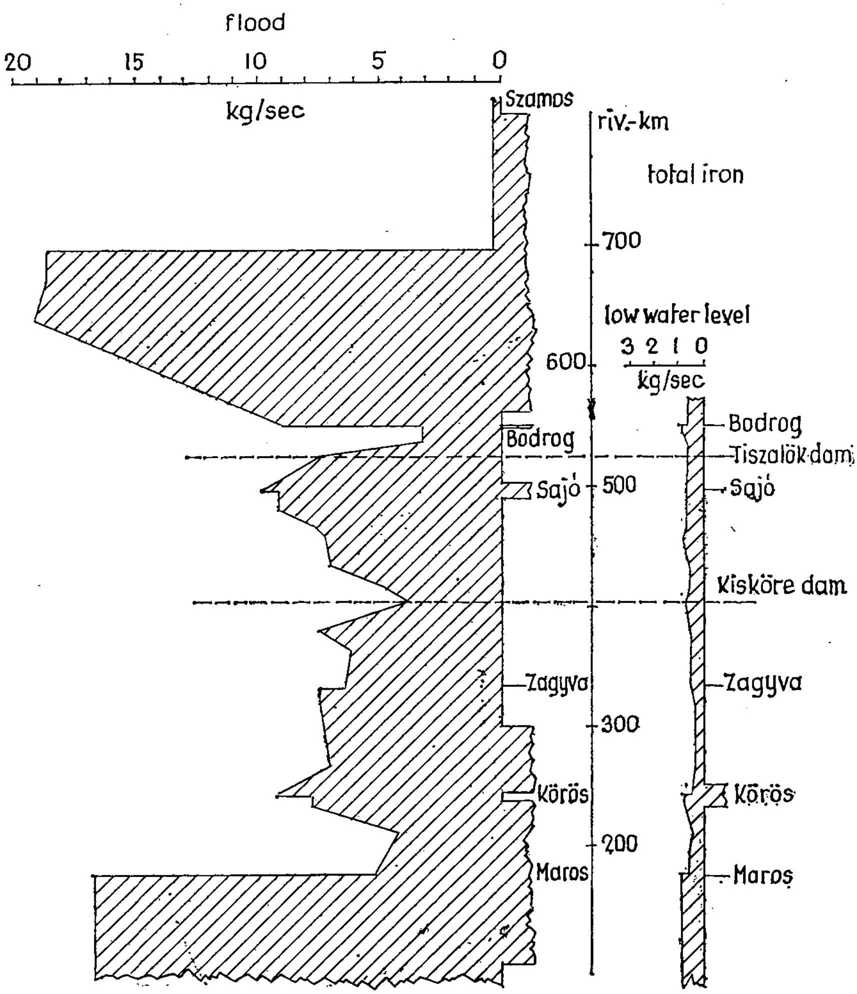

Fig. 8. Formation of the output of the total iron in the longitudinal section of the Tisza.

on content. The high COD Chr (27.35 mg/l) and COD Chr (55.04 mag/l) of the Sajó water made their effect on the Tisza, as well.

The COD aMn values changed — as the influence of the Zagyva can be considered owing to its low water output, as practically negligible — up to the mouth of the Kőrös between 11.0 mg/l and 8.0 mg/l. After the inflow of the Kőrös a decrease of 2—3 mg/l was observed. At Tápé (river km 177) 5.86 mg/l was measured.

The COD Chr of the Tisza water initially rose, under the influence of the Sajó, by 10—15 mg/l (at Tiszakeszi (riv. km 467) to 37.35 mg/l. at Tiszacsege (riv. km 457) to 35.38 mg/l); then, in its longitudinal section, a further decrease in values could e observed (Csongrád (riv. km 245) to 18.84 mg/l.

Owing to the diluting effect of the Kőrös, at Tápé (river km 177) there was already measured not more than 10.61 mg/l. The chemical oxygen requirement of the Tisza water was repeatedly increased by the flooding Maros, the CODaMn of which was 15.03 mg/l, and its COD Chr 31.45 mg/l. In the sampling section below Szeged, the COD aMn of the water was 11.96 mg/l, and its COD Chr 23.59 mg/l.

Dissolved mineral-matter content

The investigated water-body has arrived at the section at Tivadar (river km 718) with a dissolved mineral-matter content and output — sodium (10.51 mg/l; 2.2 kg/s), potassium (0,5 mg/l; 0.1 kg/s), calcium (32.1 mg/l; 6.9 kg/ s), magnesium (5.5 mg/l; 1.2 kg/s), chloride (15.6 mg/l; 3.34 kg/s), sulphate (2.26 mg/l; 0.5 kg/s), and hydrogen-carbonate (141.57 mg/l; 29.9 kg/s).

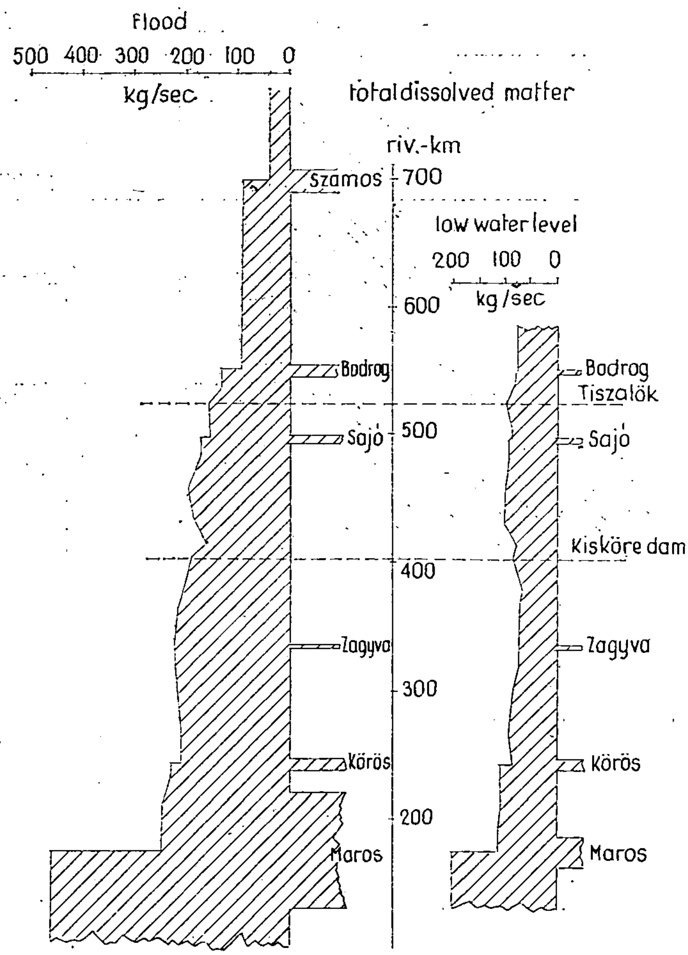

Fig. 9. Formation of the output of the total dissolved matter in the longitudinal section of the Tisza.

Under the influence of the Szamos, the dissolved mineral-matter content of the Tisza water has increased. In the sampling section above the mouth of the Bodrog, up to the frontier of the country, from among the single kations and anions, the concentration of soidum and magnesium in the longitudinal section did not increase. Potassium showed an increase of 78 per cent, calcium 45, hydrogen-carbonate 11, chloride 41, and sulphate 268 per cent increase. In the sampling section in Szeged (river km 173) 16.0 mg/l sodium, 4.0 mg/l potassium, 48,1 mg/l calcium, 9.2 mg/l magnesium, 157.43 mg/l hydrogen-carbonate, 34.4 mg/l chloride and 30.48 mg/l sulphate concentrations were measured.

In case of the dissolved mineral-matter output — depending on the quantity of the mineral matter transferred by tributaries — we have observed a still more considerable increase.

Thus, we have measured in the sampling section in Szeged (river km 174) from among the kations 12 times as much as the initial output of sodium — at Tivadar (river km 718) — (26.6 kg/s), 66 times as much as that of potassium (6.6 kg/s), 12 times as much as that of calcium (79.9 kg/s), 14 times as much as that of magnesium (15.3 kg/s). From among the anions, the output of hydrogen-carbonate rose to 10 times as much (29.9 kg/s), that of chloride to 18 times as much (59.5 kg/s), that of sulphate to 105 times as much (52.5 kg/s).

The initial concentration of the total dissolved matter (162 mg/l) has increased by 84 per cent, and its output (34.2 kg/s) by 1348 per cent in the longitudinal section. In the sampling section in Szeged (river km 174), there were achieved 298 mg/l and 495.2 kg/s values, respectively (Fig. 9).

Phosphorus and nitrogen forms

The investigated water-body arrived at the sampling section at Tivadar (river km 718) with 112 mg/cubic m total phosphorus content and 23.6 g/s output. Under the influence of the flooding Szamos (436.0 mg/c. m; 78.9 g/s), the total phosphorus content increased to 6 times as much as the initial concentration (668.0 mg/cubic m), and its output to 11 times as much as the initial value (261.9 g/s).

As at flooding a considerable part of the quantity of the total phosphorus was formed by phosphorus connected with the suspended matter (phosphorus being in the organic fragments, water-insoluble, biologically inactive calcium-, magnesium-, aluminium-, iron-, etc. phosphates), thus in the longitudinal section the concentration and output of the total phosphorus changed in connection with the suspended matter (Fig. 10).

After evaluating the data from the point of view of trophity, we have established that the investigated water-body belonged — on the basis of the total phosphorus content — into the polytrophic category. That is to say, the cessation of the inhibiting factors (much suspended matter, strong flow regimen etc.) in the whole stretch of the Tisza in Hungary would have enabled the polytrophic state to be brought about (FELFÖLDY 1974). The total phosphorus content measured in the flooding Tisza is, of course, much higher than the biologically available total phosphorus. The phosphorus quantity of the water-body, that is undoubtably exclusively accessible to the living organisms, is therefore given by the dissolved orthophosphate-phosphoric concentration. If we qualify the degree of trophity of the investigated water-body on the basis of the dissolved orthophosphate-phosphorus, then we determine the minimum trophic state that can develop in the water if the production-inhibiting factors cease to be.

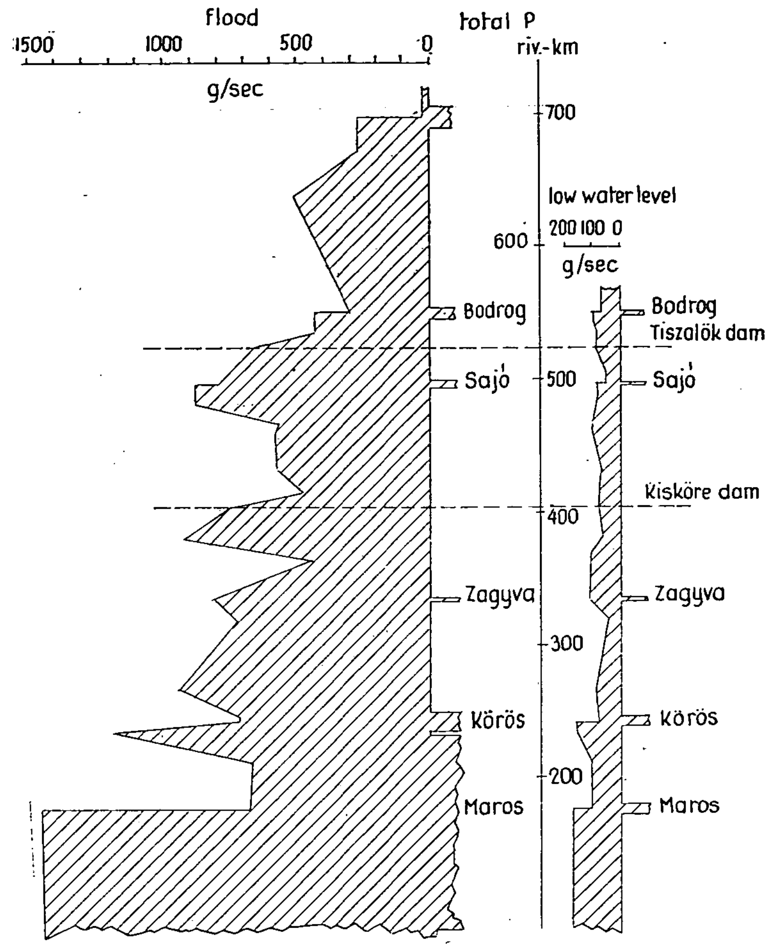

Fig. 10. Formation of the poutput of the total phosphorus in the longitudinal section of the Tisza.

The investigated water-body was up to the mouth of the Szamos oligotrophic again. From the mouth up to the frontier of the country — as a result of the Szamos water — it contained enough quantity of dissolved orthophosphate-phosphorus for bringing about the polytrophic state and exceeded, on every occasion, the 20 mg/cubic metre value which can be considered as a critical concentration of algal blooms (VOLLENWEIDER 1968).

The knowledge of the nitrogen content — in the flow of which the aquatic living world has a determinative part — is fundamentally necessary to form an opinion of trophities. The investigated water-body has arrived with 2320 mg/cubic metre total nitrogen content and 0.5 kg/s output at the sampling section at Tivadar (river km 718). After the mouth of the Szamos, the concentration of the total nitrogen increased to about two times as much and, remaining in an approximately standing

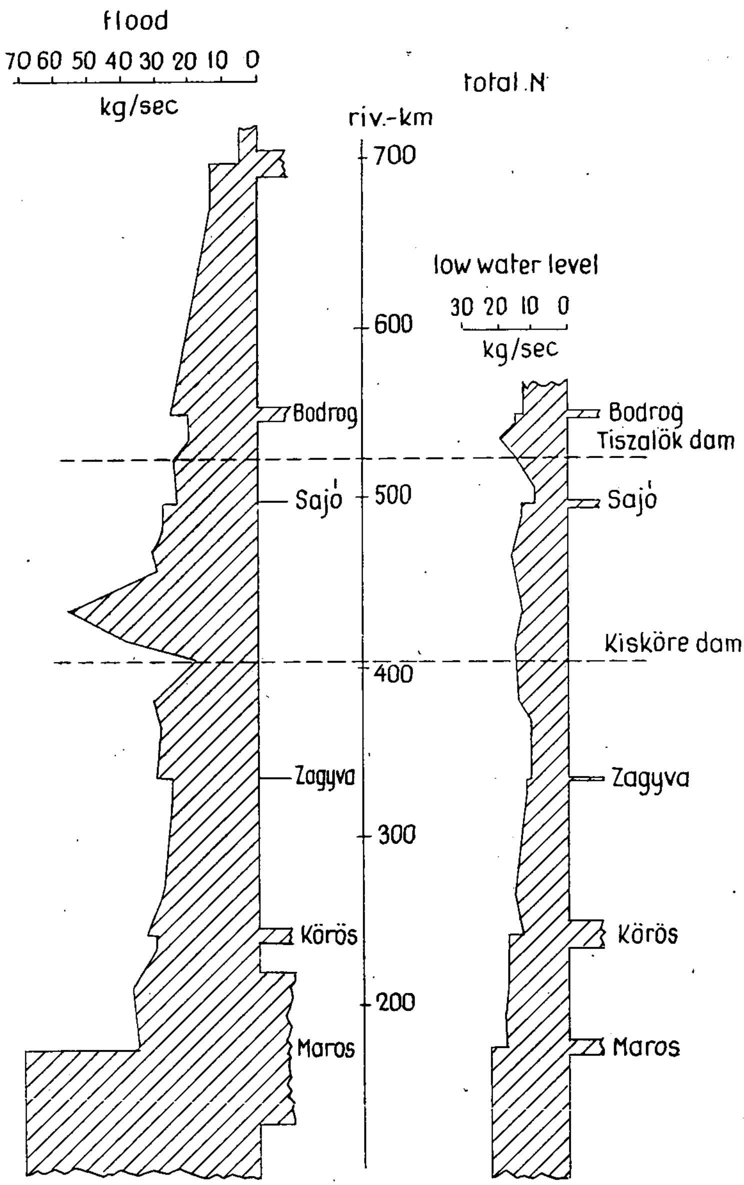

Fig. 11. Formation of the output of the total nitrogen in the longitudinal section of the Tisza.

value in the longitudinal section, left the frontier of the country with 4123 mg/cubic metre. Its output increased in the longitudinal section. We have measured after the mouth of the Szamos — at Tiszaszalka (river km 673) — 1.2 kg/s, after the mouth of the Bodrog — at Tiszaladány (riv. km 535) — 1.9 kg/s, after the mouth of the

Sajó — at Polgár (riv. km 486) 2.7 kg/s, after the mouth of the Zagyva — at Tiszavárkony (riv. km 320) — 2.5 kg/s, after the mouth of the Kőrös — at Szentes (riv. km 234) — 3.0 kg/s, after the mouth of the Maros — in the sampling section below Szeged (riv. km 168) — 6.8 kg/s values (Fig. 11).

The quantity of the mineral nitrogen (nitorgen of inorganic bond) on every occasion surpassed 300 mg/cubic metre, designated as a dangerous threshold value from the point of view of eutrophication (VOLLENWEIDER 1968, FELFÖLDY—TÓTH 1970).

The investigated water-body contained — on the basis of 895 mg/cubic metre, measured in the sampling section at Tivadar (river km 718) — sufficient quantity of mineral nitrogen for the formation of a eu-polytrophic state until the mouth of the Szamos, for that of a eu-polythrophic, resp. polytrophic state from the inflow of the Szamos until the mouth of the Sajó (1074 mg/c. metre — 1605 mg/c. metre), for that of a polytrophic state from the inflow of the Sajó until the frontier of the countra (FELFÖLDY 1974).

Results of the investigation of the low-water period

Physical conditions

In the time of the longitudinal section water temperature varied between 17.9 and 22.0 °C, the mean temperature of the investigated period was 19.9 °C. In accord ance with the temperature conditions of the late-summer — early-autumn period, there were measured less temperature differences than in June between the day-time maxima (21 to 22 °C) and the minima of small hours (18 to 20 °C).

The temperature difference decreased in the longitudinal section of the river, as well. It was established from the values measured in approximately identical hours that the water is only by 1°—1.5 °C warmer at the sampling sites below Szeged than it was initially.

The investigated water-body was characterized until the inflow of the Bodrog by a greyish-yellow, and from the mouth of the Bodrog down to the frontier of the country — corresponding to the low-water period — by a greenish-yellow colour.

Transparency of the water was 2—6 times greater than at the longitudinal section in July. After the mouth of the Bodrog — at Tokaj (river km 545) — there was measured a value of 27 cm, at Kisköre — above the river barrage (riv. km 404) — that of 45 cm, and in the sampling section below Szeged a values of 50 cm.

The suspended matter content of the investigated water-body was—corresponding to the low-water period low, in the decisive majority of samples only 12—20 per cent of the values measured in flood-time. In the longitudinal section, the suspended matter concentration fluctuated but to a lesser degree. There were obtained in the sampling section above the Bodrog (river km 551) 43.6 mg/l, at Tokaj (riv. km 545) 44.2 mg/l, aat Tiszalök (riv. km 525) 44.0 mg/l values.

In the range of the Kisköre River Barrage, there took place a visible decrease in concentration. At Kisköre (riv. km 404) the suspended matter of the water-body was 25.2 mg/l.

The suspended matter content of the water leaving the dammed reaches was increasing again. There were measured at Tiszaroff (river km 380) 35.8 mg/l, at Tiszavárkony (riv. km 320) 46.2 mg/l, at Csongrád (riv. km 235) 29.6 mg/l, and in the sampling section below Szeged (riv. km 168) 36.4 mg)'l concentrations.

The suspended matter output, measured in the identical sampling sections, has only reached 3 to 8 per cent of the values obtained in the time of flood. We have observed the gradual decrease in the output of the water-body which had an almost constant, about 15—17 kg/s suspended matter output from the mouth of the Bodrog until the beginning of the range of Kisköre damming. At Kisköre, there was already measured 7.5 kg/s, the half of the initial values.

There was observed a minor increase in the suspended matter output of the water-body leaving the dammed reaches, only after the inflow of the single tributaries— as a result of the suspended matter content of them.

Thus, the suspended matter output of the water-body increased after the mouth of the Zagyva from 11.0 kg/s to 12.3 kg/s, after the mouth of the Kőrös from 8.9 kg/s to 14.3 kg/s, after the mouth of the Maros from 14.5 kg/s to 19.4 kg/s, and to 20.0 kg/s in the section below Szeged (Fig. 7).

Water-chemical conditions

The total iron content reached not more than 10 to 20 per cent of the values measured in the time of flood. In the longitudinal section — like in case of suspended matter — there was observed only a minor fluctuation. We have obtained generally about 1.7 mg/l concentrations. The total iron output was 3—10 per cent of the values measured in the time of flood.

The investigated water-body arrived at the mouth of the Bodrog with 0.6 kg/s output. The value risen under the influence of the Bodrog (0.8 kg/s) gradually decreased until Tiszalök (river km 524) then, until Tiszacsege (riv. km 457) it remained on 0.6 kg/s value. From Tiszafüred (river km 433), a minor decrease followed repeatedly and until Csongrád (riv. km 235) 0.3—0.5 kg/s values were obtained. The total iron output of the water-body was raised by the Kőrös by 0.3 kg/s, and by the Maros by 0.2 kg/s, and left the frontier of the country with 0.8 kg/s value (Fig. 8).

The pH of the investigated water-body was generally by 0.3 higher than those measured in the time of flood. In the longitudinal section a minor decrease was experienced. There were predominating until Szolnok (riv. km 355) the higher pH 7.7—7.5 and from Szolnok until the sampling section below Szeged (riv. km 168) rather the lower pH 7.5—7.4 values.

The dissolved oxygen content of the Tisza water has shown a considerable difference from that observed in flood-time.

Because of the slow watercourse, the atmospherical oxygen, getting in, due to water motion, dominated less and less. The considerably lower suspended matter content and the long-lasting sunny fine weather enabled the photosynthetic oxygen production of the water-body to be started. Thus, the oxygen engendered in the day-time rather by the production, and getting in at night — under the influence of the decrease in temperature — by the surface diffusion, decreased the dissolved oxygen content of the water. That is to say, the values measured in the day-time and the small hours became more balanced.

In the longitudinal section — in contradistinction to those experienced in the time of flood — there was observed the progressive increase in the concentration of the dissolved oxygen and the oxygen-saturation of water. From the sampling section above the mouth of the Bodrog (river km 551) until Tiszaderzs (riv. km 415) there were generally measured values about 3—4 mg/l and saturations about 40—50 per cent. At Kisköre (riv. km 404) the dissolved oxygen content rose to 5.58 mg/l and at Tiszaroff (riv. km 380) to 9.23 mg/l. Saturation reached 61 and later even 104 per cent!

From Tiszaroff (river km 380), a change followed in the weather — the sky was clouded in 10—90 per cent — thus, the dissolved oxygen content of the investigated water-body did not continue rising any more, its saturation was again reduced below 100 per cent. Until the sampling section below Szeged (river km 168) — depending on the weather—there were generally measured 6—7 mg/l concentration and 70—80 per cent saturation.

The free oxygen content of the investigated water-body was generally lower than the values measured in the time of flood, it as a rule varied between 5—10 mg/l. In the longitudinal section, a minor rise in concentration could be observed.

The oxygen requirement of the Tisza water, measured with acid potassium permanganate and potassium dichromate (further on: CODaMn and CODChr respectively), was until the mouth of the Sajó by 7—10 mg/l, resp. 10—15 mg/l lower than the values received in the time of flood, first of all owing to the low suspended matter content.

Under the influence of the Sajó — the CODaMn of which was 44.8 mg/l, the CODChr 160.0 mg/l — the CODaMn of the Tisza water rose by 4—5 mg/l and its CODChr by 2—7 mg/l, and at Kisköre (river km 404) there was measured 8.16 mg/l, resp. 19.4 mg/l.

From Kisköre, the chemical oxygen requirement of the investigated water-body more and more decreased. After the mouth of the single tributaries, however, which had arrived with a higher organic-matter content, the values again rose.

In the sampling section below Szeged the CODaMn of the water was 6.84 mg/l and the CODChr reached 25.2 mg/l.

The dissolved mineral-matter content of the investigated water-body — corresponding to the low-water period — was generally higher than in the period of flood. From among the kations, the concentration of sodium was higher by 3—20 mg/l, that of calcium by 4—12 mg/l, that of potassium and magnesium by 1—4 mg/l, and from among the anions that of chloride by 2—10 mg/l and that of sulphate by 10—30 mg/l than the values measured in flood time. In case of hydrogen-carbonate, there were measured at both longitudinal sections approximately identical quantities.

In the sampling section above the mouth of the Bodrog (river km 551), sodium was 20.75 mg/l, potassium 2.25 mg/l, chloride 29.0 mg/l, and sulphate 17.63 mg/l. In the longitudinal section — primarily under the influence of tributaries — the increase in the concentration of kations and anions was kept under observation.

The Bodrog has raised mainly the magnesium content of the water-body (by 5.3 mg/l; 70 per cent), the Sajó the calcium and sulphate contents (by 7.2 mg/l, 16 per cent, resp. by 15.9 mg/l; 60 per cent), the Zagyva the sodium and sulphate contents (by 7.0 mg/l; 27 per cent, resp. 2.7 mg/l, 72 per cent), and the Maros the calcium, chloride and sulphate contents (by 18.9 mg/l, 33 per cent; 65.0 mg/l, 203 per cent; resp. 15.4 mg/l, 32 per cent). In the samping section at Szeged (river km 173) the concentration of sodium (30.75 mg/l) has shown 48 per cent, that of potassium (9.75 mg/l) 333 per cent, that of calcium (76.2 mg/l) 65 per cent. that of magnesium (11.7 mg/l) 56 per cent, that of hydrogen-carbonate (194.04 mg/l) 33 per cent, that of chloride (97.0 mg/l) 235 per cent, and that of sulphate (61.88 mg/l) a 251 per cent increase.

The output of the kations and anions of the investigated water-body did not surpass, in the conclusive majority of cases, the outputs reached in flood time. The outputs of sodium and potassium were almost identical on the occasion of the two investigations; that of calcium was lower by 10—30 kg/s, that of magnesium by

2—10 kg/s, that of chloride by 4—12 kg/s, and that of sulphate by 4—20 kg/s than in flood time.

In the longitudinal section, the outputs of potassium, calcium, and sulphate more and more increased; in the sampling section in Szeged (river km 174) there were measured 6.7 times, 2.6 times, resp. 5—6 times as much output as the initial one.

The output of sodium began rising from the inflow of the Zagyva, and those of magnesium and chloride from the mouth of the Kőrös. At Szeged (river km 174) we have measured 9.8, 2.5, as well as 5.3 times as much as their initial output. The output of sodium began rising from the inflow of the Zagyva, that of magnesium and chloride from the mouth of the Kőrös. At Szeged (river km 174) their output increased to be 9.8, 2.5, as well as 5.3 times as much.

The output of hydrogen-carbonate remained at almost standing — about 60—70 kg/s — values.

The total dissolved matter content was higher by 3—55 per cent, the output was lower by 17—95 per cent than those observed in flood time. In the longitudinal section, the initial concentration (219 mg/l) increased by 110 per cent, and the initial output (75.3 kg/s) by 237 per cent. In the sampling section at Szeged (river km 174) we have reached 462 mg/l, resp. 254.1 kg/s (Fig. 9).

The total phosphorus content (162—495 mg/cubic m) and output (60—200 g/s) of the investigated water-body have only reached 30—40 per cent of the phosphorus content and 10—20 per cent of the output of flood time. In the longitudinal section, the values have considerably increased after the mouth of the single tributaries (Fig. 10).

In the low-water period, the water-body contained — primarily because of its low suspended matter content — considerably less formed sestonic phosphorus of inorganic bond. Its total phosphorus content was therefore given, apart from the dissolved orthophosphate phosphorus and the dissolved non-reactive phosphorus, first of all, by the biologically available formed organic phosphorus — being in dead or living organisms.

Evaluating the data from the point of view of trophity, we have established that the investigated waterbody contained phosphorus of sufficient quantity for forming — on the basis of the total phosphorus content — a polytrophic, and on the basis of the dissolved orthophosphate phosphorus an eutrophic state and, on any occasion, exceeded the 20 mg/cubic m value which can be considered as the critical concentration of algal blooms. The concentration of the total nitrogen (3036—6804 mg/cubic metre) was by 10—20 per cent higher, and its output (0.9—2.8 kg/s) 40—50 per cent lower, than those measured in flood time. In the longitudinal section — mainly under the influence of the tributaries — the values gradually increased. And in the sampling section below Szeged (river km 178) the 27 per cent increase in the initial concentration and the 89 per cent increase in the initial output was measured. In case of the mineral nitrogen content, there were achieved nearly the same amounts as those measured in flood time which have on every occasion surpassed the 300 mg/cubic metre limiting concentration, designated as a threshold value which is dangerous from the point of view of eutrophication. Evaluating these contributions from the point of view of trophity, we have established that the investigated water-body contained a sufficient quantity of mineral nitrogen for forming until the mouth of the Sajó a (1092—1309 mg/c.m) eu-polytrophic, and from the inflow of the Sajó until the frontir of the country a (1550—2746 mg/c. m) polytrophic state.

References

ÁDÁMOSI, M. et al. (1974): A duzzasztás hatása a Tisza vízminőségére a Kiskörei Vízlépcső térségében. (The effect of damming on the water-quality of the Tisza in the region of the Kisköre River Barrage). — Hidrol. Közl. *12*, 570—576.

ÁDÁMOSI, M. (1978): Hidrológiai viszonyok, in Ádámosi et al, 1978 (Hydrological conditions Ádámosi et al, 1978): Limnológiai vizsgálatok a Tisza hossz-szelvényében (Limnological investigations into the longitudinal section of the river Tisza). — Tiscia (Szeged).

BOGÁRDI, J. (1971): Vízfolyások hordalékszállítása (Floating-matter transport by watercourses Publishing House of the Hungarian Academy of Sciences. Budapest, 1—837.

FELFÖLDY, L. (1969): Álló- és folyóvizek hidrobiológiája (Hydrobiology of standing and river waters). Budapest. (Manuscript).

FELFÖLDY, L.—TÓTH, L. (1970): A mezőgazdaság kemizálásának hatása a vízgazdálkodásra II. (Effect of the chemizati of agriculture on the management of water-supplies II), VIZDOK, Budapest, 1—196.

FELFÖLDY, L. (1974): A biológiai vízminősítés. (Biological water-qualification). — Vízügyi Hidrobiológia 3. VIZDOK, Budapest, 1—242.

KATONA, S. (1976): Some results of the chemical investigation of the river Tisza in 1974. — Tiscia (Szeged) *11*.

T. DVIHALLY, Zs. (1963): Adatok a Duna-víz kémiai viszonyainak értékeléséhez. (Contributions to the evaluation of the chemical conditions of Danube-water). — Hidrol. Közl. *3*, 268—271.

T. DVIHALLY&VÁGÁS, I. (1966): A Duna-víz klorid tartalmának és lúgosságának jellegzetes változásai az 1965. évi tavaszi áradások során. (Characteristic changes in the chloride content and alkalinity of the Danube-water in the course of the spring-floods in 1965). — Hidrol. Közl. *6*, 273—277.

VÁGÁS, I. (1963): Gondolatok és javaslatok a Duna-víz kémiai viszonyainak értékeléséhez. (Idea and suggestions to the evaluation of the chemical conditions of the Danube-water). Hidrol. Közl. *6*, 526—527.

VOLLENWIEDER, R. A. (1968): Scientific fundamentals of eutrophication of lakes and flowing water with particular reference to nitrogen and phosphorus as factors in eutrophication. — Water Manag. Res.

BACTEOROLOGICAL INVESTIGATIONS IN THE LONGITUDINAL SECTION OF THE TISZA

MÁRIA B. TÓTH and J. HAMAR

It is the quantity of the heterotrophic bacteria in the water, of a larger size than 0.45 μ which can be determined by the method of direct number (OVERBECK 1974). According to our experience, the bacteria occurring in the Tisza are generally tiny cocci. Their average diameter is 0.7 μ which corresponds to 0.1795 cubic μ. They have, therefore, a very small volume. According to Overbeck (1974), the bacteria of the Plussee are of a volume between 1.2 to 6.6 μ.

The numbers of bacteria per millilitre, counted by the direct method, are extremely different and depend upon the degree of the organic-matter load, as well (BERLAND et al. 1975, OVERBECK 1972, 1974, PATIL et al. 1975, ROMANENKO 1973, SIVKO et al. 1972, TILZER 1972, RODINA 1960, 1964, OLÁH—VÁSÁRHELYI 1970). In oligotropic waters this number is lower than 100, in eutrophic water it is 10^4—10^6 ind/ml, while in sewage-water their number is of the order 10^7—10^9 ind/ml. In the mentioned literature, not one of the freshwater values is reaching the values of the total bacterial number in the Tisza (HAMAR 1976, HAMAR et al. 1975). The suspended matter content of the Tisza is very high in flood time. The organic-matter content of the suspended matter originating from the runoff from land (VÉGVÁRI 1976) is considerable. Thus, the suspended matter and the total bacterial number are in a positive correlation with each other.

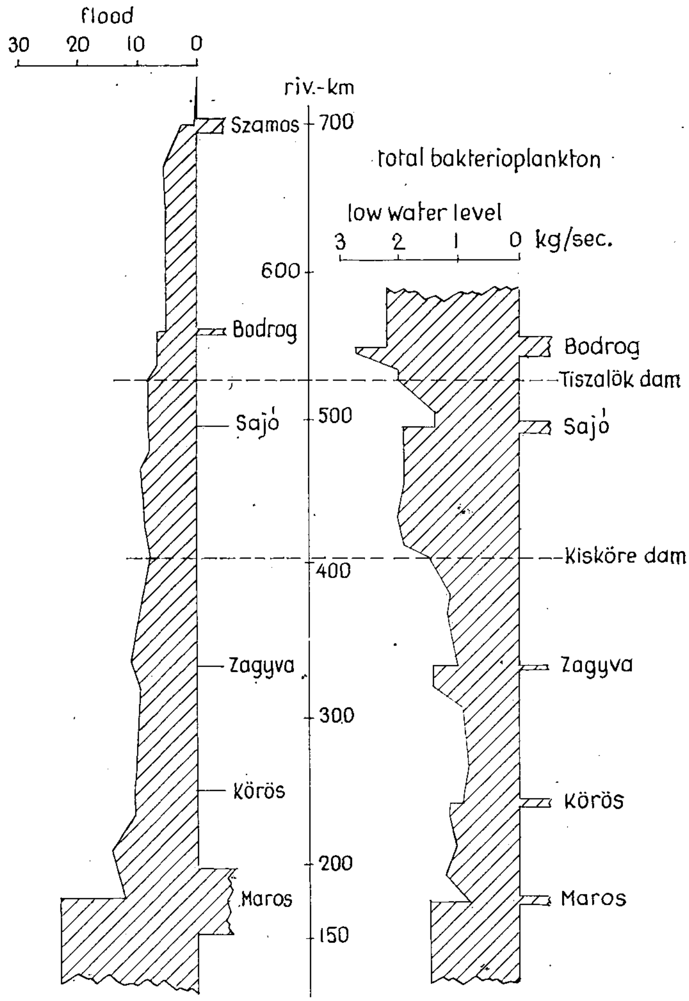

Fig. 12. Mattercurrent of the bacterioplankton in the longitudinal section of the Tisza.

(a) Flood time

In flood time, the performed longitudinal-sector investigation found a high total bacterial number connected with a high suspended matter content. In the Upper Tisza Region, when there was no flood and so the suspended matter content was low — the total bacterial number was also low (5.74 million ind/ml, 1.03 g/cubic metre). The bacterial content of the flooding Szamos (71.39 million ind/ml) determines the values of the further bacterial number in the Tisza (average is about 75 million ind/ml). Maximum is reached below the Maros at Szeged (92.27 million ind/ml; 16.56 g/c.m).

The values are rather high and they approach all the values of sewage water, as well as those of the activated mud (Overbeck 1974, Patil et al. 1975, Paluch

1965). It can be noted as a fact that the bacterial content originating from the runoff from the soil — at least in regard to its quantity — may exert a lasting effect on the river (NIEMELÄ 1973 and the literature quoted by him).

The values of the mattercurrent investigated in flood time are high. After the flooding Szamos, the value of the bacterial biomass passing through the cross-section is 2 to 25 kg/sec. From among the tributaries, the values of the flooding Szamos and particularly those of the similarly flooding Maros are high (Fig. 12).

(b) Period of low water

In case of low water, despite the low suspended matter content, the values of the total bacterial number are high (12—38 million ind/ml). The change in the values of the biomass passing through the cross-section (0.8—2.7 kg/sec) is similar to the diagram of suspended matter (Fig. 12).

References

BERLAND, B. R. et al. (1975): Bactéries Hétérotrophes Aérobies Prélevées devant le Delta du Rhône. I. — Hydrobiologia *3—4*, 481—494.

HAMAR, J. (1975): Data to the bacteriological and algological conditions of the region of Kisköre River Barrage. — Tiscia (Szeged) *11*, 41—44.

HAMAR, J.—BANCSI, I.—B. TÓTH, M.—VÉGVÁRI, P. (1975): Data to the hydrobiology of the Middle and Lower Tisza Regions. — Tiscia (Szeged) *11*, 67—75.

NIEMELA, S. (1973): Connection between the bacterial content of the Mahaweli River and of some adjacent soils. — Verh. Int. Verein. Limnol. 18, 1313—1319.

OLÁH, J. (1968): A quantitative study of the saprophytic and total bacterioplankton in the open water and the littoral zone of Lake Balaton in 1968. — Annal. Biol. Tihany *36*, 197—212.

OLÁH, J. (1970): Short periodic changes in the microbial plankton quantity of Lake Balaton. — Annal. Biol. Tihany *37*, 199—207.

OLÁH, J.—VÁSÁRHELYI, R. (1970): Comparative bacteriological investigation of the shallow Hungarian lakes with different trophic levels. — Annal. Biol. Tihany *37*, 223—234.

OVERBECK, J. (1972): Experimentelle Untersuchungen zur Bestimmung der bakteriellen Produktion im See. — Verh. Int. Ver. Limnol. *18*, 176—187.

OVERBECK, J. (1974): Microbiology and biochemistry. — Mitt. Int. Ver. Limnol. *20*, 198—228.

PATIK, H. S. et al. (1975): Succession in zoo- and phytoplankton in sewage stabilization pond. — Hydrobiologia *47*, 253—264.

RODINA, A. G. (1960): Mikrobiologya razresenii vaprosov biologitcheskoy produktivnosti vodaemov. — Trudnii abedinennoy nausnoy sektsii II, 331—338.

RODINA, A. G. (1964): Mikrobiologitscheskie isledovaniya reki Oki. — Trudii zoologtcheskogo instituta *32*.

ROMANENKO, V. I. (1973): Abundance and production of bacteria in Latvian lakes. — Verh. Int. Ver. Limnol. *18*, 1306—1310.

TILZER, M. (1972): Bacterial productivity of a high-mountain lake. — Verh. Inter. Ver. Limnol. *18*, 188—196.

VÉGVÁRI, P. (1975): Water motion in the Tisza and its connection with the suspended matter content. — Tiscia (Szeged) *11*, 17—20.

INVESTIGATION INTO THE PHYTOPLANKTON IN THE LONGITUDINAL SECTION OF THE RIVER TISZA

J. HAMAR

The Tisza has a characteristically high suspended matter content — primarily in flood time (VÉGVÁRI 1976) — and this has a decisive influence on the dynamism of the total algal number (HAMAR 1976a). In such a way, there is a considerable difference to be found between the algological conditions of flood time and low-water time (UHERKOVICH 1971).

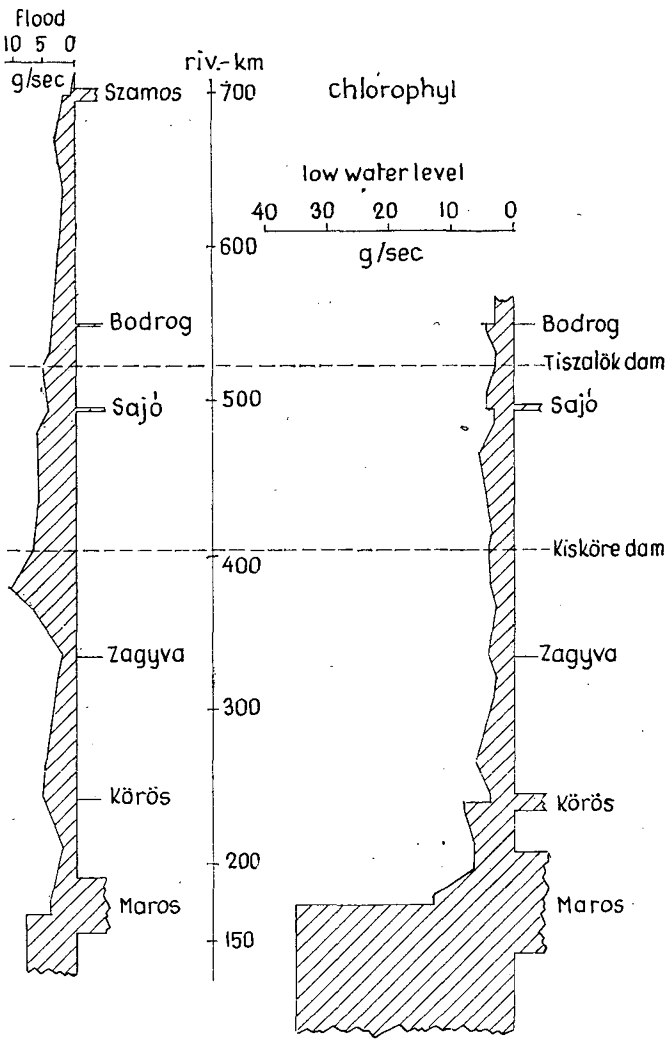

Fig. 13. Mattercurrent of the total chlorophyll content.

(a) Flood time

Owing to the character of flood, the total algal number, was very low, it varied between 96 and 252 thousand ind/l and in the longitudinal section a slow, gradual increase is to be observed. In the stock the diatoms are dominant. The rheonic elements *(Diatoma vulgare, Ceratoneis arcus, Gomphonema olivaceum, Synedra ulna)*, which are characteristic of the Upper Tisza Region, are replaced in the Middle and Lower Tisza Regions by the planktonic ones *(Nitzschia acicularis, Stephanodiscus tenuis, Cyclotella meneghiniana)*. The taxon count is very low (5—15), its rise in the longitudinal section is slow and gradual.

Apart from the Szamos — by which the character of the phytoplankton is fundamentally determined — the effect of no other tributary and polluting source can be demonstrated.

Corresponding to the flow regimen the chlorophyll content was very low, it varied between 2.15 and 13.47 mg/cubic metre "a"-(Chlorophyll 1.02—6.79), and constantly fluctuated in the longitudinal section. The values of the tributaries are low. The largest is that of the Maros, with 12.89 mg/c.m. The values of the matter-current are also low (0.3—10.5 g/sec) (Fig. 13).

(b) Low-water time

In case of low water, a euplanktic stock of considerably higher taxon- and individual numbers was observed. The taxon count in the longitudinal section more and more increases (28—62). But after dammings it decreases.

From among the blue-green algae, the picture of the stock is fundamentally determined by *Anabaenopsis raciborskii* which had presumably got into the Tisza from the Lónyai-canal (riv.km 556), joined by *Microcystis aeruginosa* and *Aphanizomenon flos-aquae*, having come from the Bodrog (riv.km 550). These three species pass through the Tisza and even some supply arrives from the tributaries. The initial individual number and the participation ratio of *Anabaenopsis raciborskii* is in the phytoplankton very high ($3150 \cdot 10^3$ ind./ml, 94 per cent), then in the longitudinal section it more and more decreases (Fig. 14).

The presence of flagellates (Euglenophyta) is negligible.

From among the dinoflagellates (Pyrrophyta), the *Cryptomonas* species proliferate as a result of damming at Kisköre and are also later present in the plankton. Their maximum individual number is $438 \cdot 10^3$ ind./l, their participation ratio is maximum 24.9 per cent in the Lower Tisza Region.

From the family of the yellowish-brown algae (Chrysophyceae), *Chrysococcus biporus* — indicating supposedly a eutrophic water — can be found in the longitudinal section, almost to the very end. The change in the situation of the Tisza up till now has been indicated by the occurrence of some colourless flagellates *(Heterochromas vulgaris, coronata, socialis, Monas cylindrica, uniguttata)*, not demonstrated there till now. These organisms feed on formed organic matter (*e. g.*, bacterium, alga) and, until a major pullution of water, take the part of the same food-niche as zooflagellates do (Hajdu 1975, Hamar 1976).

After the decrease in the individual number of blue-green algae, the individual number and participation ratio of diatoms (Bacillariophyceae), and among them those of *Stephanodiscus tenuis, Melosira distans*, increase in the Middle Tisza Region (from 2.3 to 37.2 per cent at Kisköre).

The dominance of green algae is characteristic of the Lower Tisza Region. Below Szeged, they reach even 65.1 per cent. From these, the cosmopolite green

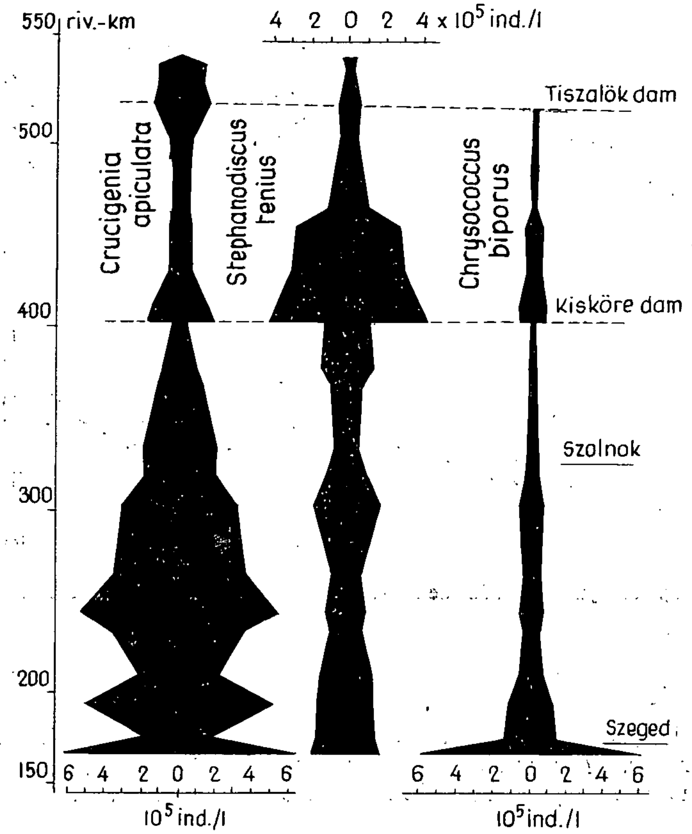

Fig. 14. Quantitative change in the phytoplankton of the low-water period.

algae (*Ankistrodesmus falcatus, Crucigenia apiculata, tetrapedia, Scenedesmus* sp.) predominate.

The individual number of more than one alga has shown definite dynamism (Fig. 15). Quantitative changes were primarily caused by damming at Kisköre and in the lower stretch.

In Table I, the drawings of some infrequent species are shown. The algae, sensitively responding to changes, give answers to several essential questions. It is worth emphasizing the most important ones of these.

1. Sources of pollution

It is shown by the diagram (Fig. 14) that the filamentous blue-green algae (Anabaenopsis raciborskii), getting in from the Lónyai-channel, are present in several millions ind./l in the samples above Tokaj (river km 551). Their mass have an important part in the Tisza stretch in Hungary until Kisköre (river km 404). And even in the sampling site below Szeged (river km 173), several hundred kms far from the origin, there can be found some thousand ind./l.

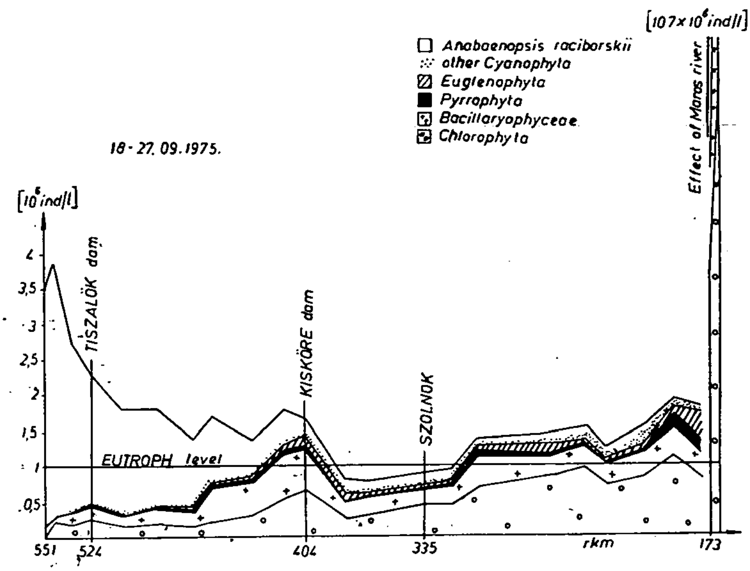

Fig. 15. Dynamism of some algae in the longitudinal section of the Tisza.

2. Tributaries

The Bodrog is known as a eutroph-indicator and its blue-green algae *(Aphanizomenon flos-aquae, Microcyctis aeruginosa)*, which engender algal blooms, like the previous blue-green algae, can be found in the water of the whole Tisza stretch in Hungary.

The algological effect of the Sajó was local, while that of the Zagyva could not be demonstrated.

In the eutrophic water of the Kőrös, a large mass of blue-green algae, similar to those in the Bodrog, could be found.

By the Maros, so large algal mass was transported into the Tisza that in the samples from below Szeged the number of algae increased to five times as much as before. First of all, a mass of green algae and diatoms have developed.

3. Dammings

The effect of dammings at Tiszalök, but primarily at Kisköre, on increasing the algal count is well shown by the graphs (Figs 14&15). The standing-water character is favourable for the proliferation of algae (HAMAR 1976).

4. Change in the stretch-character of the river

If we take for our basis the classical division which distinguishes between stretches of upper, middle and lower character then, in or case, the lower-stretch character of the river is only clearly prominent. This manifests itself in the increased number of algae and the appearance of recent species. It is to be supposed, at any rate, on the basis of the microscopic investigations that this presents itself together with the effect of the sewage waters of the town Szolnok.

5. Eutrophic state

A water containing more than 1 million ind./l algal number is generally named eutrophic (FELFÖLDY 1974). In the present case, with the exception of the reaches between Kisköre and Szolnok, the water of the Tisza is of eutrophic character, and in the reaches at Szeged — under the influence of the Maros — it is already eupolytrophic. It seems to us that the eutrophic state slowly becomes characteristic of the Tisza.

The effect of pollutions could be demonstrated on the basis of chemical and bacteriological investigations in the stretch below the Sajó and Szolnok. The investigated Tisza reaches are of a—b mesosaprobic character — that is to say, slightly polluted. It is to be feared that — as a result of the artificial interventions (river barrages, increasing pollution) — the river looses its ability for self-purification which was so far characteristic of it. It can be said of it that — owing to the high nutrient content and the effect of dammings — in the initial stretch an algal association developed which responded to the different effects first of all by changing the quantitative conditions.

Despite the low-water, the chlorophyll content was low, it varied between 8.99—20.88 mg/m^3 in the upper and middle stretches. It increased in the lower stretch and reached its maximum below the Maros (57.01 mg/cubic metre). We also get a low value after investigating the matter-current, and this is considerably increased by the influence of the Maros, as well (Fig. 13). There we have measured values between 4—31 g/sec.

The effect of tributaries

Bodrog: The taxon (30) and individual number (570 thousand ind./l) is low. *Microcystis aeruginosa* and *Aphanizomenon flos-aquae,* causing water colouration in its water, can also be found in the water of the Tisza in the reaches below its mouth.

Sajó: In its water the planktonic diatoms *(Stephanodiscus, Nitzscia* spp.) dominate. The water is, taking into consideration the total algal count, of eutrophic character.

Zagyva: In its water of low taxon (24) and individual number (570 thousand ind./l) the diatoms dominate. There are to be found several rheonic elements in it. The water is rather qualified as polluted.

Kőrös: Its water-colouration was strong *(Microcystis aeruginosa, Aphanizomenon ros-aque).* The high taxon-number (41) and individual number (1417 $\cdot$ 10^3 ind./l) flefer to a eutrophic water. In its water the green algae dominated.

Maros: The taxon (47) and individual number (15 $\cdot$ 10^6 ind./l) is very high. In its water cosmopolite green algae dominated. Its eutrophic water exerted a considerable effect on the Tisza (Fig. 14).

References

FELFÖLDY, L. (1974): Biológiai vízminősítés (Biological water qualification). Vízügyi hidrobiológia. — Budapest.

HAJDÚ, L. (1975): A paraphysomonas vestita előfordulása hazánkban (Occurrence of Paraphysomonas vestita in this country). — Bot. Közl. *62,* 9—12.

HAMAR, J. (1976 a): Data to the bacteriological and algological conditions of the region of Kisköre River Barrage. — Tiscia (Szeged) *11,* 41—44.

HAMAR, J. (1976 b): About the algae of the Kisköre River Barrage and environs. — Tiscia (Szeged) *11,* 45—58.

UHERKOVICH, G. (1971): A Tisza fitoszesztonja (Phytoseston of the Tisza). — Szolnok.
VÉGVÁRI, P. (1976): Water motion in the river Tisza and its connection with the suspended matter content in 1974. — Tiscia (Szeged) 11, 17—20.

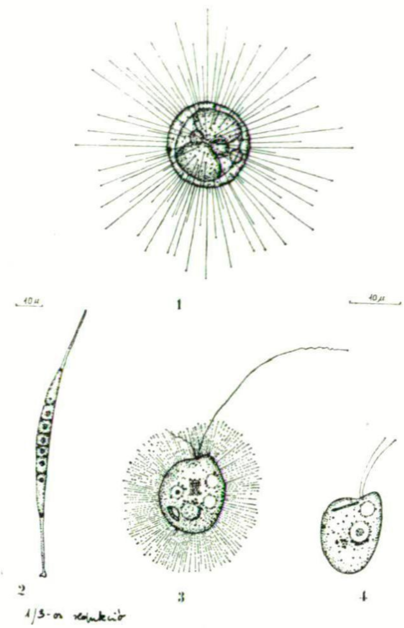

Plate I

1. *Siderocystis fusca* KORSCHIK. /*Siderotytopsis fusca* (KORSCHIK) SWALE.
2. *Lambertia gracilipes* (LAMBERT) KORSCHIK.
3. *Monas coronifera* SKUJA
4. *Cyathomonas truncata* (FRESENIUS) FISCH.

INVESTIGATION INTO THE ROTATORIA AND CRUSTACEA COMMUNITIES OF THE PLANKTON

I. BANCSI

Antecedents

The Rotatoria and Crustacea fauna of the Tisza stretch in Hungary are known in several relations on the basis of earlier investigations (BANCSI 1975, ÉBER 1955, GÁL 1963, MEGYERI 1955, 1957, 1970, 1972). Such an investigation of the Rotatoria and Crustacea fauna in the longitudinal section, however, which was studying the changes in the same waterbody, took place in case of the Tisza the first time at present.

Following the water-body chosen enables the multiplication of species to be studied. This helps us at revealing the ecological differences of the various river reaches. By extending the investigation into more than one group of living beings, a comprehensive picture can be brought about the ecological peculiarities of the river.

The results of the hydrological, water-chemical, algological and other studies performed in the course of the investigations (June 8—16, September 18—27, 1975), are contained in further papers of the article-series. In this paper I am dealing with the Rotatoria and Crustacea plankton of the Tisza and its tributaries. The results of investigations are included in Table 1.

Results

By the first longitudinal-section investigation (June 8—16), the study of the ecological, faunistical conditions of a flood time was made possible. In this period there were found altogether 53 Rotatoria, 5 Cladocera, 3 Cyclopoida and 1 Calanoida taxons in the Tisza and its tributaries. It is characteristic of most species that each of them occurs but in a single stretch of the river, then is missing for a longer or shorter time, and again appears, producing on this occasion a considerable individual density. On the other hand, it is only characteristic of fewer species that — even if in a changing individual number — they are to be found almost constantly in the same water-body.

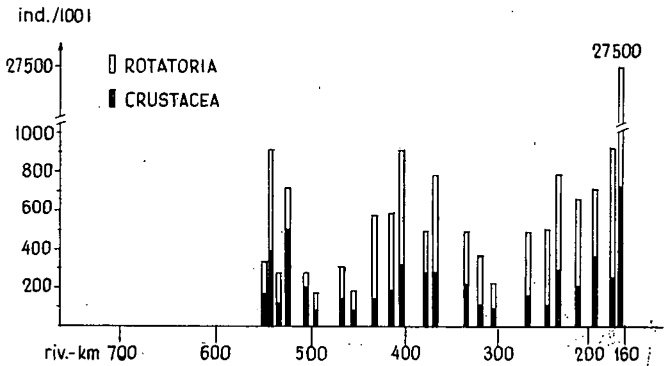

Fig. 16. Quantitative dynamism of the Rotatoria and Crustacea plancton in the longitudinal section of the Tisza, between June 8 and 16, 1975.

In the investigated period, in the about 200 km upper-stretch of the Tisza, there were found a low species number (3 to 7) and small individual density (100 to 250 ind./100 l), in respect of the Crustacea plankton (Fig. 16). In the sample taken above the Tiszalök River Barrage (river km 524) we could already demonstrate 400 ind./100 l. This datum of investigation is showing in itself that — despite the flood time — the dammed reaches ensure obviously more favourable conditions for the zooplankton organisms. There were found in the samples from the area above the Kisköre River Barrage (river km 404) 12 to 20 taxons with more than 500 to 800 ind./100 l, and between river kms 266 to 173 22 to 26 taxons. The individual density has, however, remained similar to those observed in the stretch above the Kisköre River Barrage.

In the Middle Tisza Region, the area of the town Szolnok (river kms 335—320), both the species and the individual numbers considerably decreased. — Below the Maros, the individual density of the Rotatoria and Crustacea plankton exceeded 2.000 ind./100 l.

The plankton-picture of the river constantly changes because the species forming the fauna appear and spread according to stretches. In the whole Hungarian stretch of the Tisza there could only be found a few Rotatoria species, among them *Polyarthra vulgaris, Rotaria rotatoria, Synchaeta oblonga.* The species of the *Keratella* genus *(e. g., Keratella cochlearis cochlearis, Keratella cochlearis* var. *macracantha* f. *macracantha)* were nearly constant representatives of the plankton from the dammed reaches at Kisköre on. In the lower stretch, the fauna of the river is enriched — in addition to the above-mentioned species — by the representatives of the *Brachionus* genus *(Br. angularis, Br. bennini, Br. calyciflorus* var. *dorcas* f. *spinosa, Br. leydigi* var. *quadratus).*

From the order Cladocera, the frequency of *Bosmina longirostris* is only worth mentioning which could be found in the region of Kisköre and in the Lower Tisza Region in individual density 30—70 ind./100 l.

The number of Copepoda larvae (nauplius, copepodit) is considerable in the whole investigated Tisza stretch, generally changing between 100 and 200 ind./100 l. The number of the well-developed individuals is sparse; in the upper stretch, they did not get into the samples. From the Kisköre region on, *Acanthocyclops vernalis* and *Thermocyclops oithonoides* regularly occurred. — Calanoida were represented by *Eudiaptomus gracilis.* Their well-developed individuals were found in the Middle- and Lower-Tisza Regions.

In flood time, from among the tributaries, the fauna of the Szamos was the poorest. There were found not more than three Rotatoria species and but a few Copepoda larvae.

The species composition of the Bodrog is similar to that of the Tisza. Owing to the damming at Tiszalök, in the water becoming slower before the mouth, there is an opportunity to the development of a rich zooplankton stock.

The plankton-picture of the Sajó considerably differs from that of the Tisza. This can be explained by the pollution of the river. A majority of the species getting into the Tisza only survived in a minor stretch.

The fauna of the Zagyva may be considered as rich both in respect of the number of species and in that of individuals. As its watermass is, however, negligible as compared with that of the Tisza, its effect is not perceptible in the Tisza.

Similar conditions are to be observed in case of the Kőrös, as well.

From among the tributaries, the Rotatoria fauna of the Maros was the most abounding. Several species *(Asplanchna priodonta, Brachionus calyciflorus* var. *dorcas, Pedalia mira)* could be found in its water in an almost 1.000 ind./100 l individual density.

In flood time, the Rotatoria and Crustacea faunas of the Tisza proved to be rather abundant. This may be explained by the elements getting into it from the watershed area. A large mass of zooplankton organism could namely be carried by the flood from the dead arms, borrowing pits lying in the flood-plain of the Tisza and its tributaries. In spite of that the investigated watermass had in about 8 days passed, in case of more species *(Brachionus angularis, Filinia longiseta, Keratella cochlearis, cochlearis)* the change in the individual number could be observed by sections.

The increase or decrease in the individual number of the mentioned species is well showing the effect of river barrages (Tiszalök, Kisköre River Barrages), that of the larger sources of sewage water (e. g. Sajó, the town Szolnok), and of tributaries, as well as the change in the stretch-character of the river.

In the course of the second longitudinal-section investigation (on September 18—27), there were found 51 Rotatoria, 7 Cladocera, 1 Calanoida, and 5 Cyclopoida taxons in the Tisza and the mouth of its tributaries. The individual density of the species found is low, despite the low-water period (Fig. 17). The quantitative data well demonstrate the ecological effect of dammings and change in the stretch-character: in the dammed reaches and the lower stretch of the river the plankton-

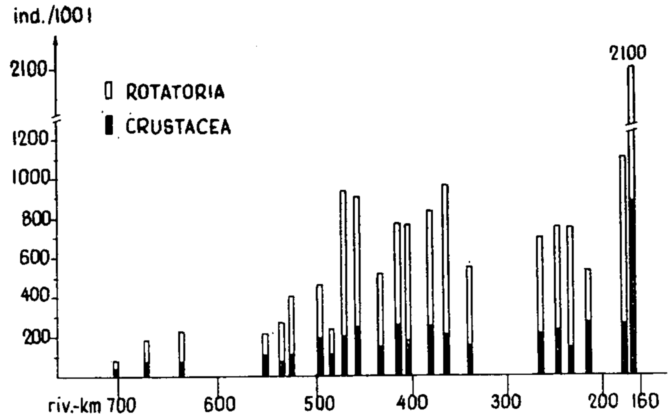

Fig. 17. Quantitative dynamism of the Rotatoria and Crustacea plancton in the longitudinal section of the Tisza, between September 18 and 27, 1975.

density of Rotatoria and Crustacea is considerably greater. — It is striking that while in the period of the previous investigation-series the number of Rotatoria was considerably higher, at present the quantity of Crustacea approaches the number of Rotatoria. The Copepoda larvae, found in a higher number, and the well-developed Cyclopoida species *(Acanthocyclops vernalis, Eucyclops serrulatus, Thermocyclops oithonoides)* are pointing to a declining period of the autumn Rotatoria maximum.

The conditions of the Tisza, which flows slower and transports less water, can be considered as a more favourable environmental factor. In the low-water period, in case of more than one Rotatoria species, we could observe their conduct in different sections of the river. The *Polyarthra* and *Synchaeta* species *(Polyarthra vulgaris, Synchaeta oblonga)* could be found in the whole investigated stretch. The *Keratella* species *(Keratella cochlearis cochlearis, Keratella qadrata)* occurred in an individual number changing according to sections. The ovulating, well-developed individuals of the *Brachionus* species *(Brachionus angularis, Br. calyciflorus* var. *dorcas, Br. diversicornis)* can be found in relatively higher numbers in the dammed reaches, resp. in the Lower-Tisza Region.

From among the tributaries, the fauna of the Bodrog and Szamos has proved to be the most abundant, now too. The majority of the species getting from the

Bodrog into the Tisza *(e. g., Filinia longiseta, Keratella quadrata, Syncheta pactinata)* can be found in the whole further stretch. In the Maros, there was found an obviously great zooplankton-density (166.000 ind./100 l). As a result of this, the earlier 700 ind./100 l individual number has also risen in the Tisza to 27,500 ind./100 l.

It is evidenced by the contributions of the two longitudinal section investigations that the Tisza has an own plankton, formed by the strongly selected small part of the species to be found in the watershed area. There occurred the ovulating fertile individuals of the majority of the species found, as well. The fact that in the region of the river dammages, and in the lower stretch of the river, the individual number of the investigated groups is higher, is indicating the sensitive response of the species forming the plankton to the changed or modified conditions.

References

BANCSI, I. (1975): Zooplankton investigations in dammed River Tisza reaches. — Tiscia *11*.

ÉBER, Z. (1955): A Kárpát-medence folyóinak planktonja (Plankton of the rivers in the Carpathian Basin). — Hidrol. Közl. *35*, 56—72.

GÁL, D. (1963): Das Leben der Tisza XX. Die Zusammensetzung der Mikrofauna des Wassers der Tisza bei Szolnok. — Acta Biol. Szeged. *9*, 69—73.

MEGYERI, J. (1955): Planktonvizsgálatok a Tisza szegedi szakaszán (Plankton investigations in the Tisza-reaches at Szeged). — Hidrol. Közl. *7—8*, 280—292.

MEGYERI, J. (1957): Planktonvizsgálatok a Felső-Tiszán (Plankton investigations in the Upper-Tisza Region). — Szegedi Ped. Főisk. Évk., 67—68.

MEGYERI, J. (1970): A Tisza mezoplanktonja I. (Mesoplankton of the Tisza I.) Rotatoria. — Szegedi Tanárképző Főisk. Tud. Közl., 115—130.

MEGYERI, J. (1972): Zooplanktonvizsgálatok a Tisza mellékfolyóin (Zooplankton investigations in the tributaries of the Tisza). — Szegedi Tanárk. Főisk. Tud. Közl., 63—73.

Table 1. *Contributions of the plankton investigation of the longitudinal-section investigation of the Tisza.*

Samplingpoints	Tisza		Szamos		Bodrog		Sajó		Zagyva		Kőrös		Maros	
Taxon	I.	II.	I.	II.	I.	II.	I.	II.	I.	II.	I.	II.	I.	II.
ROTATORIA														
Anuraeopsis fissa (GOSSE)	+	+				+		+						+
Asplancha priodonta (GOSSE)	+	+				+					+	+	+	
Asplancha siboldi (LEYDIG)	+	+							+				+	
Brachionus angularis (GOSSE)	+	+			+	+	+	+	+				+	+
Br. bennini (LEISSLING)	+										+			
Br. budapestiensis DADAY	+	+												
Br. calyciflorus var. *amphiceros* (EHRB.)	+	+									+		+	
Br. caly. var. *dorcas* f. *spinosa* (WIERZEJSKI)	+	+			+	+			+		+		+	+
Br. caly. var. *dorcas*	+	+								+				+
Br. diversicornis DADAY	+	+			+									
Br. falcatus ZACHARIAS	+	+				+								
Br. leydigi var. *quadratus* (ROUSSELET)	+	+												
Br. quadridentatus HERMANN	+					+			+		+			
Br. quadr. var. *brevispinus* (EHRB.)	+	+				+			+		+			
Br. quadr. var. *cluniorbicularis* SKOR.		+												
Br. quadr. var. *entzi* (FRANCÉ)	+													
Br. quadr. var. *rhenanus* (LAUTERBORN)		+												
Br. urceolaris O. F. MÜLLER	+	+					+		+		+			
Cephalodella catellina (O. F. MÜLLER)	+													
Cephalodella ventripies DIXON-NUTALL		+							+					
Colurella adriatica EHRB.		+					+							
Colurella colurus (EHRB.)	+				+				+					
Conochilus unicornis ROUSSELET	+													
Dicranophorus caudatus (EHRB.)	+	+												
Dicranophorus sp.	+													
Euchlanis alata VORONKOV	+													
Euchlanis dilatata EHRB.	+				+		+			+	+			
Euchlanis triquetra EHB.	+										+			
Euchlanis sp.	+													
Filinia longiseta (EHRB.)	+	+			+	+			+		+		+	+
Habrotrocha sp.	+													
Itura aurita (EHRB.)	+	+												
Kellicottia longispina (KELLICOTT)	+	+			+									+
Keratella cochlearis cochlearis GOSSE	+	+				+								+
K. coch. var. *irregularis angulifera* LAUTERBON	+	+				+								
K. coch. var. *macracantha* f. *micrracantha* LAUT.	+	+	+		+	+			+			+		+
K. coch. var. *tecta* (GOSSE)	+	+	+		+	+					+	+	+	
K. testudo (EHRB.)	+				+		+						+	
K. valga (EHRB.)					+									
K. quadrata (O. F. MÜLLER)	+	+				+								
K. quad. var. *reducta* FADEEW		+				+								
Lecane bulla (GOSSE)		+						+						
Lecane closterocerca (SCHADRA)	+	+							+	+	+			
Lecane flexilis (GOSSE)		+												
Lecane hamata (STOKES)	+	+												
Lecane lunaris (EHRB.)		+							+		+			
Lepadella ovalis O. F. MÜLLER	+								+					
Lepadella patella O. F. MÜLLER	+	+					+		+					
Lepadella rhomboides GOSSE		+												
Mytilina *videns* LEVANDER										+				
Notholca squamula (O. F. MÜLLER)	+													
Notomata copeus (EHRB.)		+												
Platyias patulus (O. F. MÜLLER)		+												
Platyias quadricornis (EHRB.)		+												
Pedalia mira (HUDSON)	+												+	
Philodina sp.	+													
Polyarthra dolychoptera IDELSON		+												
Polyarthra euryptera WIERZEJSKI		+												
Polyarthra major BRUCHHARDT		+												

Table 1

Samplingpoints	Tisza		Szamos		Bodrog		Sajó		Zagyva		Kőrös		Maros	
Taxon	I.	II.	I.	II.	I.	II.	I.	II.	I.	II.	I.	II.	I.	II.
Polyarthra vulgaris CARLIN	+	+	+		+	+		+	+		+	+	+	+
Pompholyx sulcata HUDSON	+	+							+	+	+		+	
Rotatoria macroceros (GOSSE)								+						
Rotaria neptunia (EHRB.)		+												
Rotaria rotatoria (PALLAS)	+	+			+	+	+	+					+	
Synchaeta oblonga EHRB.	+	+			+	+	+		+		+			
Synchaeta pectinata EHRB.	+	+					+				+			
Trichocerca capucina (WIERZEJSKI u. ZACH)		+												+
Tichocerca cylindrica (IMHOF)		+				+			+					+
Trichocerca pusilla (JENNINGS)						+			+					
Trichotria pocillum (O. F. MÜLLER)	+				+	+								
Trichotria tetractis (EHRB.)		+												+
Taxon														
Cladocera	48	49	3	×	15	20	9	6	18	5	16	4	12	12
Alona rectangula SARS						+								
Bosmina longisostris (O. F. MÜLLER)	+	+			+		+		+					+
Ceriodaphnia quadrangula (O. F. M.)	+													
Chydorus sphaericus (O. F. MÜLLER)	+	+				+							+	
Daphnia cucullata SARS	+	+												
Daphnia longispina O. F. MÜLLER		+												+
Diaphanosoma brachiurum		+												
Disparalona rostrata (KOCH)						+								
Moina rectirostris (LEYDIG)		+												
Pleoruxus adunsus (JURINE)						+								
Taxon														
Copepoda														
Cyclopoida	4	6	—	×	1	4	1	—	1	—	—	—	1	2
Acanthocyclops vernalis FISCHER	+	+				+	+						+	
Cyclops vicinus ULJANINE		+												
Eucyclops serrulatus FISCHER	+	+												
Megacyclops viridis JURINE		+								+		+		
Thermocyclops oitthonoides G. O. SARS	+	+			+			+		+		+		+
NAUPLIUS	+	+	+		+	+	+	+	+	+	+		+	+
Taxon														
CRUSTACEA														
Cladocera	3	5	—	×		2	1	1		2	—	2	1	1
Alona rectangula SARS														
Bosmina longirostrsi (O. F. MÜLLER)	+	+			+		+		+					+
Ceriodaphnia quadrangula (O. F. M.)	+													
Chydorus sphaericus (O. F. MÜLLER)	+	+				+							+	
Daphnia cucullata SARS	+	+												
Daphnia longispina O. F. MÜLLER		+												+
Diaphanosoma brachiurum		+												
Disparalona rostrata (KOCH)						+								
Moina rectirostris (LEYDIG)		+												
Pleuroxus aduncus (JURINE)						+								
Taxon														
Copepoda														
Cyclopoida	4	6	—	×	1	4	1	—	1	—	—	—	1	2
Acanthocyclops vernalis FISCHER	+	+				+	+						+	
Cyclops vicinus ULJANINE		+												
Eucyclops serrulatus FISCHER	+	+												
Megacyclops viridis JUNINE		+								+		+		
Thermocyclops oithonoides G. O. S.	+	+				+		+		+		+		+
NAUPLIUS	+	+	+		+	+	+	+	+	+	+		+	+
Taxon														
Calanoida	3	5	—	×	—	2	1	1	—	2	—	2	—	1
Eudiaptomus gracilis G. O. SARS	+	+			+	+								
NAUPLIUS	+	+				+		+						
Taxon														
	1	1	—	×	1	1	—	—	—	—	—	—	—	—

ZOOFLAGELLATE INVESTIGATIONS IN THE LONGITUDINAL SECTION OF THE RIVER TISZA

J. HAMAR

There have been twelve species identified from the Tisza:

Bicoeca Lacustris J. CLARK
Bodo angustus (DUJ.) BÜTSCHLI
Bodo spora SKUJA
Bodo varians (STOKES) LEMM.
Codonosiga botrytis (EHRB.) KENT
Codonosiga longipes STOKES
Monosiga varians SKUJA
Pleuromonas jaculans PERTY
Rhynchomonas nasuta (STOKES) KLEBS
Bodo celer KLEBS
Salpingoeca bütschlii LEMM.

Pleuromonas jaculans and *Rhynchomonas nasuta* are cosmopolite species. *Bicoeca lacustris, Salpingoeca bütschlii,* and the *Codonosiga* species are organisms settled down on euplanktic algae — primarily on diatoms.

It is only *Bodo angustus* that occurs in sewage-waters. In its entirety, the stock never shows any pollution.

ZOOBENTHOS INVESTIGATIONS

MAGDOLNA, FERENCZ

From the middle stretch of the Tisza, zoobenthos has only been investigated, up to the present, in the Tiszafüred—Kisköre region (SZITÓ 1973, 1974). There have been no data concerning investigations of this character, as yet, in the Sajó and Zagyva.

In the course of the longitudinal-section investigation in the laboratory of river barrage Tisza II, the elaboration of deposit-samples collected in three days led to the following results.

Sampling sites and their zoobenthos fauna

Bottom-samples were taken in the Tisza-stretch between river kms 497 and 334, either from one of the riversides or from both of them (cf. Fig. 1).

1: Tisza-part above the mouth of the Sajó, river km 497, left side, 5 m from the riverside, water-depth 2.6 m. The bottom is clayey sand, with blackened vegetable debris. Zoobenthos is only Oligochaeta. Dominant species: *Limnodrilus hoffmeisteri,* CLAP.

2: At the same place, right riverside, 8 m from the riverside, water-depth 3 m. Zoobenthos is formed by six taxonic groups, in a low individual number (except for Oligochaeta). The dominant Oligochaeta species of the sandy bottom, abounding in detritus are: *Euilyodrilus danubialis* HRABE and *Isochaetides Isochaetides newaensis* MICHAELSEN.

3: Sajó, 200 m from the mouth, right side, 5 m from the riverside, water-depth 2.6 m. The bottom is gravelled coarse sand with much vegetable debris. The Oligochaeta species are in a high individual number (dominant species is: *Limnodrilus hoffmeisteri* CLAP.), in addition: a few Chironomida and Gastropoda.

4: Tiszapalkonya, river km 488. Right side, 4 m from the riverside, water-depth 2.6 m. The bottom is gravelled sand, with vegetable debris. From among the three taxonomic groups, the individual number of Oligochaeta was again high. (Dominant species is: *Euilyodrilus danubialis* HRABE).

5: At the same place, left side, 6 m from the riverside, water-depth 2.5 m. The bottom is sandy. There are four taxonomic groups, equally represented by one individual each. Oligochaeta: *Euilyodrilus danubialis* HRABE.

6: Tiszacsege, left side, 12 m from the riverside, water-depth 3.4 m. The bottom is sandy. From among the five taxonomic groups, here are dominant: Gastropoda (*Lithoglyphus naticoides* PFEIFFER). The representing species of the low-number Oligochaeta group is: *Isochaetides newaensis* MICHAELSEN.

7: At the same place, right side, 8 m from the riverside, water-depth 2.8 m. The bottom is coarse sand, rough detritus. Oligochaeta (dominant species: *Isochaetides newaensis* MICHAELSEN) have the comparatively highest individual number. Mollusca (*Unio* sp., *Dreissena polymorpha* PALLAS, *Lithoglyphus naticoides* PFEIFFER) are fewer.

8: Tiszafüred, left side, 8 m from the riverside, water-depth 2.5 m. The bottom is clayey sand, not so much vegetable debris. From among five taxons, Oligochaeta (dominant species: *Euilyodrilus danubialis* HRABE) were again dominant, with a few Mollusca (*Lithoglyphus naticoides* PFEIFFER, *Anodonta* sp.).

9: At the same place, right side, 5 m from the riverside, water-depth 2.4 m. The bottom is sandy clay, detritus. Dominant group: Oligochaeta, with one representative each: Nematoda, *Diptera-Branchycera, Unio* sp., *Anodonta* sp.

10: Kisköre, river km 406. Left side, 8 m from the riverside, water-depth 0.5 m. The bottom is muddy, with much enough, fine detritus. There are comparatively more Oligochaeta, the dominant species is: *Branchiura sowerbyi* BEDDARD. In addition: 1 Nematoda, resp. *Diptera-Brachycera puparium.*

11: Kisköre, river km 405. Right side, 10 m from the riverside, water-depth 0.5 m. The bottom is clayey-muddy, much detritus, a little fine mica-sand. Dominant taxon is: Chironomida, then *Lithoglyphus naticoides* PFEIFFER. The fewest are here: Oligochaeta (*Limnodrilus udekemianus Clap.* and two cocons).

12: Tiszaroff, river km 380. Right side, 3 m from the riverside. The bottom is sandy-clayey, not so much vegetable debris. There were here in equal individual number: Oligochaeta (dominant species: *Isochaetides newaensis* MICHAELSEN, and comparatively more *Branchiura sowerbyi* BEDDARD).

13: Above Szolnok, river km 336. Left side, 5 m from the riverside, water-depth 1.5 m. The bottom is sandy clay, gravel, and course vegetable debris. The zoobenthos was represented by 4 *Lithoglyphus naticoides* PFEIFFER and 1 Chironomida.

14: At the same place, right side, 3 m from the riverside, water-depth 0.5 m. The bottom is clayey-muddy fine sand, much enough detritus. Dominant taxon: Diptera-Brachycera, and in addition: Oligochaeta (Lumbriculida), *Lithoglyphus naticoides* PFEIFFER, and Chironomida, one from each of these.

15: Zagyva, river km 334.5: from the middle of the mouth. Oligochaeta; dominant species: *Limnodrilus hoffmeisteri* CLAP., and two Corixida-larvae.

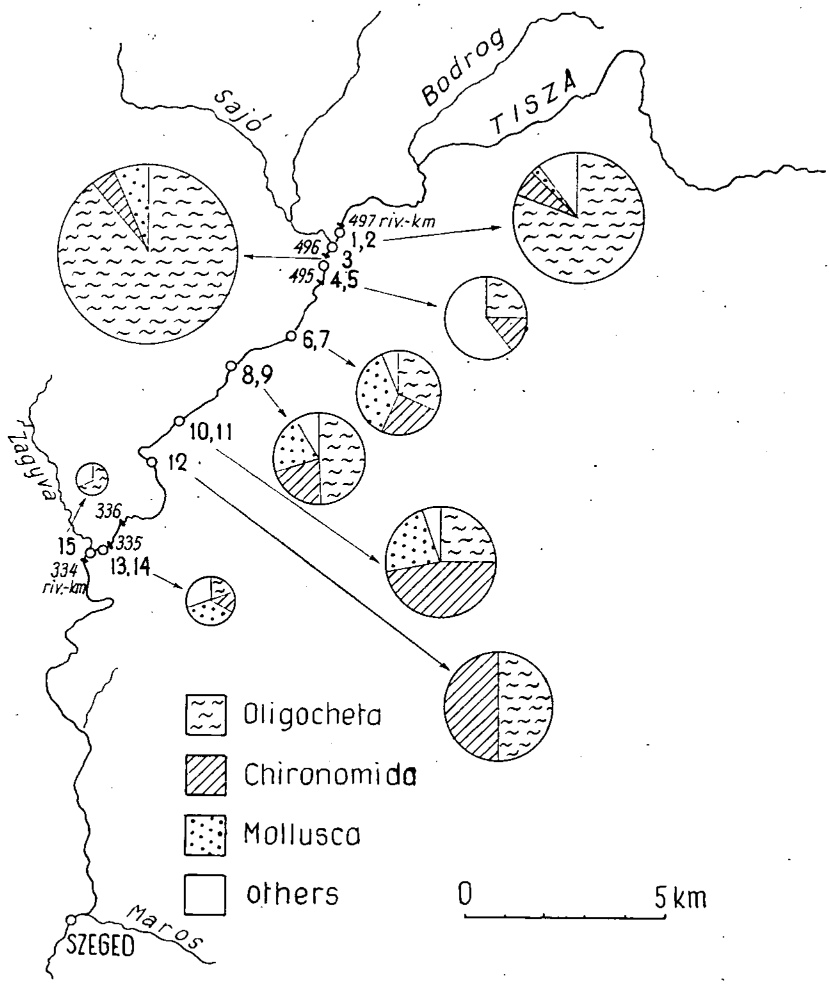

Fig. 1

Results

It was shown by the distribution of zoobenthos at sampling sites that the richest habitat was the Sajó and the poorest one the Zagyva. The most populous habitat of the river Tisza was: Nos 1+2, *i. e.* the highest sampling place (Fig. 1).

In respect of the qualitative distribution of zoobenthos, the picture is most monotonous in the Zagyva (if the Corixida taxon is not ranked among the typical bottom-living beings).

In the investigated rivers, Oligochaeta amounted to 59.5 per cent of the total zoobenthos, playing in such a way the role of the dominant group. Chironomida are 21.7 per cent, Mollusca 12.2 per cent. The other six taxons, taken as a whole, are 7.1 per cent (Diptera-Brachycera, Ephemeroptera, Nematoda, Trichoptera, Ceratopogonida, Corixida).

The determined Oligochaeta species and their percentage are as follows:

	per cent
Euilyodrilus danubialis HRABE:	27.1
Limnodrilus hoffmeisteri CLAP.:	27.1
Isochaetides newaensis MICHAELSEN:	14.3
Limnodrilus udekamianus CLAP.	11.4
Branchiura sowerbyi BEDDARD:	5.0
Euilyodrilus bavaricus ÖSCHMANN:	4.3
Tubifex tubifex MÜLLER:	3.6
Stylaria lacustria LINNÉ:	2.9
Psammoryctes moravicus HRABE:	2.1
Euilyodrilus hammoniensis MICHAELSEN:	0.7
Limnodrilus michaelseni LASTOCKIN:	0.7
Psammoryctes albicola MICHAELSEN:	0.7

The determined Mollusca species and their percentage are as follows:

Lythoglyphus naticoides PFEIFFER:	80.5
Planorbis planorbis LINNÉ:	5.5
Unio, sp.:	5.5
Dreissena polymorpha PALLAS:	2.8
Anodonta sp.:	5.5

From among the three Ephemeroptera, occuring in sampling site 2, two were *Palingenia longicauda* OLIVIER.

In the bottom samples, there occurred systematically some Kamptozoa *(Urnatelly gracilis* LEYDI) and Bryozoa organic debris.

The quantitative maximum of the zoobenthos is in the Sajó, its minimum in the Tisza-reaches at Szolnok.

The qualitative minimum of the zoobenthos is in the Zagyva.

In the Tisza, 50 per cent of the zoobenthos fell to the Oligochaeta. Dominant species: *Euilyodrilus danubialis.*

The zoobenthos of the Sajó and Zagyva consisted in still higher percentage of Oligochaeta. Dominant species in the tributaries is: Limnodrilus hoffmeisteri.

The change in the percentage of the three major taxonic groups is, going from above downwards, in sucession of sampling sites:

Oligochaeta: decreasing,

Chironomida: increasing tendency (except for Szolnok and the Zagyva),

Mollusca: maximum in the middle stretch (sampling sites 6 to 11).

References

BRINKHURST, R. O.—JANIESON, B. G. M.: Aquatic Oligochaeta of the World, Edinburgh, 1971.

SZITÓ, A. (1973): Data on the Chironomus fauna of the flood area of the Tisza at Tiszafüred—Kiskőrös. — Tiscia (Szeged) *8*, 43—47.

SZITÓ, Á. (1974): Quantitative and qualitative studies of Chironomida larvae on the section of the Tisza between Tiszafüred and Kisköre. — Tiscia (Szeged) *9*, 83—87.

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SOME ECOLOGICAL CHARACTERISTICS OF THE BIRD STOCK OF TŐSERDŐ

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Abstract

The 8-member research team of the Tisza-Research Working Committee performed regular ecological investigations into the bird-stock of the Tisza Dead-Arm at Lakitelek and the adjacent flood-plain Tős-erdő in the area of the National Park in Kiskunság, in 1976.

The most characteristic nesters of the aquatic ecosystems proved to be the following: *Podiceps ruficollis, Anas platyrhynchos, Aythya nyroca; Gallinula chloropus, Fulica atra.* The terrestrial ecosystems, on the other hand, are characterized by the bird species *Locustella fluviatilis, Luscinia megarhynchos, Sylvia atricapilla, Parus major, Certhia brachydactyla, Turdus, merula, Sturnu vulgaris, Passer montanus, Fringilla coelebs, Picus viridis, Dendrocopos major.*

The vertical distribution of bird's nests between 0.2 m and 10 m can be observed well. The bird species have not been specialized for plant species or plant associations in respect of placing the nests. The flight opening of the nest-hole looks to different quarters of the heavens.

Introduction

In 1976, in the area of the National Park of Kiskunság, in the flood-plain Tőserdő bordering on the Tisza Dead-Arm at Lakitelek and the natura lwaters belonging to that, a systematical fact-finding investigation was started, planned for two years, by an eight-member research team organized for this purpose by the Tisza-Research Working Committee. In addition to the authors of this paper, the members of this team were also LEVENTE MAGYAR, GYULA MOLNÁR, LAJOS PUSKÁS, LÁSZLÓ SALAMON. While in 1976 the emphasis was placed on collecting and evaluating the faunal, ecological and fenological data — now we want to report on the effect of the ecological factors considered as the most considerable from among these — in 1977, in continuing the work, our aim will be the quantitative investigation into the bird-stock

The investigated area and method

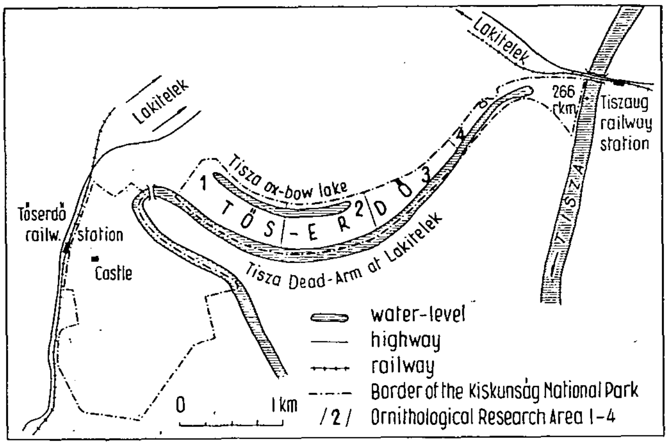
The investigated area is the Dead-Tisza and the "Carcass"-Tisza at Lakitelek, between them the flood-plain Tőserdő and meadow, lying in about five km length on the confines of Lakitelek. This is about 100 ha, of which 88 ha fall to the forest Tős-erdő (sketch-map 1).

The smaller part of the forest is the willow-poplar wood, familiar in the flood-plains of the Hungarian Great Plain *(Salix alba, Populus canescens* and *Populus nigra, Salicetum albae-fragilis,* a major part being *Populus canescens, Populus nigra,* and *Populus robusta)*, as well as a mixed stand

(Alnus glutinosa, Robinia pseudo-acacia, Populus canescens and *Populus nigra, Fraxinus anngustifolia).* The Italian poplar plantations lie in large spots. A considerable value of the area is the 3.5 ha old, peduncular oak-forest *(Quercus robur).*

The underwood is dense in the whole forest, in some places it is impenetrable *(Amorpha fruticosa, Crataegus sp., Cornus sanquinea, Rubus caesius, Urtica dioica, Aristolochia clematitis). Vitis riparia,* lying on the soil in a very large area, in the form of a dense creeper, or overgrowing the trees entirely, grows in profusion.

The investigations were performed by the members of the team in the area divided into four fact-finding districts, walking two and two. Partly they were working all the eight at an identical date, partly they were active — anybodyinh is own sector — at a freely chosen date. Surveyings were organized, in nesting season, with a monthly, weekly resp. fortnightly frequency.



Sketch map 1. The Tős-erdő
(1) Water surface. (2) Roadway. (3) Railway. (4) Boundary of the National Park of Kiskunság. (5) Area of the ornithological investigations 1 to 4.

The result of investigatior

It was ascertained in the presence of 105 bird species that 44 of these species have nested in the area (Table 2). In the following we are examining the effect of some environmental factors regulating the essential conditions of the nesters.

Birds get, as generally the living beings, into a close connection with their environment by means of the processes, resp. possibilities of subsistence (nourishment, possible protection from the effects of weather) and propagation (presence of a suitable nesting site and nesting material). There is also to be mentioned here a third factor, the man, whose activity may be of decisive importance for the development of the bird stock in our culture areas. Investigating the ecosystems of the area from a point of view like this, the following facts can be set down.

In the *aquatic ecosystem* the following characteristic types of the biotope may be found:

1. The so-called "Carcass"-Tisza is a 1.5 km long, narrow and shallow, age-worn dead-bed of the Tisza. It is, in fact, a white water-lily (*Nymphaeetum*)-covered sedge- and reed-bordered marshland, with a few stunded common alders and willows at its bank.

A large amont of vegetal and animal organic food is concentrated here but, owing to the water becoming shallow and a part of the pool extinct in summer, the continuous feeding of birds and their youngs is not ensured. Therefore, even if some opportunity to nest is provided by the vegetation of the riverside zone, there are nut very few species hatching here. The less advantageous ecological conditions are still more increased by the disturbing anthropogeneous effect. One side of the narrow water ribbon is connected with an agricultural area, the other side with a meadow and a regular communication road on it.

The hatching of not more than four species, nesting in the sedgy, resp. reeds *(Gallinula chloropus, Ixobrychus minutus, Acrocephalus arundinaceus,* and *Acrocephalus schoeonobaenus)* was established here. These species, at any rate, are characteristic not only of the "Carcass"-Tisza but also of the more and more shrinking, vegetation-covered small waters. Several bird species belonging to the orders Anseriformes, Gruiformes, Charadriiformes, and even Passeriformes come here on transient residence in order to take nourishment. The low species and individual numbers are characteristic of these, as well.

2. The small forest bog developing in the NW corner of the Tős-erdő is very interesting. Below the middle-aged peduncular oak and common alder woods, a sedge- and algal reed-grass-covered water-surface lies, with a standing water of a few rooms size and in many places polluted by iron hydroxide to be brown. Gallinula chloropus has hatched here, even in spite of the poor food.

3. The Dead-Tisza at Lakitelek is a 5 km long, 45—50 m broad Tisza Dead-Arm of open water. Its riverside is bordered with a willow-poplar, pollard--willow or poplars and sedgy-bulrush. Its water, in many places full of floating hair--weed, is in connection with the "living" Tisza by means of a canal. And in the time of high floods, it is fully refreshed with Tisza water. It follows from this that it yields a rich animal (fish, amphibian, water-insect) and vegetal food to birds.

From among the species characteristic of the water biotope of the dead arm, Anas platyrhynchos hatches in the largest number. With its nesting way, it adapted itself to the changing water surface: Its nest can be found in the aspen leaf-litter of the higher riverside in just the same way as in the 2 m high willow hole and even in a 4 m height, on a ramified branch of a willow.

By the dead arm rich in floating heir-weed, a considerable number of *Aythya nyroca* are sustained, living overwhelmingly on vegetal organisms. In some sections of the riverside they nest in an almost loose habitat. In an about 300 m long stretch 12 nests have been counted.

At high water, the nest of *Fulica atra* made of the basic material bulrush was also built here on a willow-bush standing in water. There were found some nests being 80 cm over the ground level after the flood had passed.

The typical species of the dead arm at Lakitelek are also: *Podiceps ruficollis, Ardea cinerea, Nycticorax nycticorax, Larus ridibundus, Chlidonias niger.*

The life of the bird population of the ox-bow lake is more or less disturbed by the several anglers, being active from anglers, camps, boats in the protected area almost in every part of the day.

The terrestrial ecosystem contains the biotopes of meadow and forest.

1. The meadowland is hardly suitable for the nesting of birds because of mowing there two-three times a year and of the tourists hiking on the road passing through it.

2. In the substance of T ő s - e r e d ő, there are to be found all the levels characteristic of the forests in the flood-plains of the Southern Great Plain.

From the species living at the litter and weed level and following a t e r r i c o l o u s way of life, *Phasianus colchicus* lays its eggs on the earth, among runners of brambles and birthworts, exposing these to the devastation of flood. The nest of Locustella fluviatilis was, however, found on the branch litter accumulated on the soil, choosing the high place certainly owing to the wet soil.

The species of a r b o r i c o l o u s way of life, dwelling at b u s h - l e v e l, find plenty, of nesting possibilities in the dense thorn-bush, bramblem dwarf-acacia underwood.

In the flood-plain woods of wet soil, often under water, the fallen treetrunks have particular importance. Thenest of *Luscinia megarhynchos* was found the branches of storm-felled willows, 20 cm high from the soil. *Caprimulgus euaropaeus* also nests in a similar place.

At t r u n k l e v e l, from among the nesters, particularly the nest location of the h o l e - d w e l l i n g s p e c i e s was studied.

There were investigated 36 nests of eight hole-dwelling species *(Upupa epops, Dendrocopos maior, D. minor, Parus maior, P. coeruleus, Phoenicurus phoenicurus, Sturnus vulgaris, Passer montanus)*. It was established that:

1. The species making or forming the hole themselves, as those belonging to the Piciformes ordo, hollow their nest-holes both in soft- and hardwood.

2. The hole suitable for nesting is occupied by the bird even if its opening for taking flight does not get any sunlight. Holes looking on to east, south and north have been observed. (Table 1).

The v e r t i c a l d i s t r i b u t i o n of the nesting of the bird stock in the forest of the country can be observed well. The nests of the species nesting at tree-trunk and crown levels are placed in most different heights. Lowest (0.2 m) is found the nest of *Parus coeruleus*, highest (10 m) that of *Corvus cornix* (Table 1).

The nest placing of 26 arboricolous bird nests was investigated on 14 plant species, in 83 cases. *Concerning nest placing, no specialization in plant species or plant associations is to be ascertained* (Table 1).

Our work — we think — is not only serving the basic researches of the ecosystems along the Tisza, and fixing some ecological data in respect to the natural values of our country but it is also of use for the nature conservancy and forestry practice.

References

KEVE, A. (1960): Magyarország madarainak névjegyzéke (Register of the birds of Hungary). — Budapest.

MARIÁN, M. (1975): The part of flood in the formation of the avifauna in the flood area of the Tisza. — Tiscia (Szeged) *10*, 85—89.

PETERSON, R.—MOUNTFORT, G.—HOLLOM, P. (1969): Európa madarai (The birds of Europe. In Hungary). — Budapest.

SCHÄFER, L. (1964): Héjasas Tőserdőnél (Bonelli's Eagle at Tőserdő). — Data on the avifauna of the Tőserdő. — Aquila *69—70*, 258.

SZÉKESSY, V. (1958): Aves — Madarak (Aves — Birds). — Budapest.

Table 1. *Distribution of nests according to plant species and their height over the ground surface*

Plant species	Bird species	Height (m)
Ash	*Chloris chloris*	2
	Turdus merula	3
	Sylvia atricapilla	2, 3
Oak	*Parus coeruleus*	0,8,1,5,10
	Upupa epops	0,35
	Corvus cornix	18—20
	Sturnus vulgaris	5
	Sylvia atricapilla	
	Passer montanus	5
	Coccothraustes coccothraustes	10
	Columba palumbus	2,5
Elm	*Sturnus vulgaris*	4
	Turdus merula	1
Poplar	*Sturnus vulgaris*	2, 5, 6 (N)
	Dendrocopos maior	1.5, 2, 4, 5 (S)
	Dendrocopos minor	6
	Streptopelia decaocto	3
	Turdus merula	2,2
	Sylvia atricapilla	1.2
	Hippolais icterina	5
	Turdus philomelos	0,5, 1.5, 1.6, 2
	Fringilla coelebs	2, 5, 3
	Chloris chloris	7
Willow	*Chloris chloris*	4
	Streptopelia decaocto	2.5
	Aegithalos caudatus	2, 3
	Turdus merula	1,1,1, 2,2,2
	Lanius collurio	1.5
	Luscinia megarhynchos	0:2
	Anas paltyrhynchos	4, 4 (hole)
	Passer montanus	2.5, 3, 4
	Parus coeruleus	0.2, 0.5
	Phoenicurus phoenicurus	2, 5, 3
	Dendrocopos maior	3, 3 (S), 3, 4, 6 (S), 6 (E)
	Parus maior	1, 2
Wild pear	*Turdus merula*	3
	Fringilla coelebs	3, 2
Thornbush	*Carduelis carduelis*	2
	Sylvia atricapilla	3
Nettle	*Phasianus colchicus*	on the soil
Poplar	*Corvus cornix*	8, 10, 12
	Fringilla coelebs	3
	Streptopelia decaocto	3, 5
	Caprimulgus europaeus	on the soil, on fallen trees
	Phasianus colchicus	on the soil
Dwarf acacia	*Hippolais icterina*	2
	Phasianus colchicus	on the soil
	Luscinia megarhynchos	on the soil, on drift-wood
Riverside vine		
Riverside vine texture	*Turdus philomelos*	2.5
	Luscinia megarhynchos	
	Sylvia atricapilla	
	Erithacus rubecula	
Water-lily hair-weed	*Gallinula chloropus*	at water-surface
Reed-sedge	*Gallunila chloropus*	1, 1, 1 at water-surface
	Ixobrychus minutus	1, at water-surface
Runners of brambles	*Phasianus colchicus*	on the soil

N = north S = south E = east: direction of the hole openings

Table 2. *Picture of the fauna*

Species		Month 1	2	3	4	5	6	7	8	9	10	11	12
Podiceps ruficollis	P												
Ardea cinerea	P												
Ardea purpurea	P												
Ardeola ralloides	P												
Egretta alba	P												
Nycticorax nycticorax	N												
Ixobrychus minutus	N												
Ciconia ciconia	P												
Anser albifrons	P												
Anser fabalis	P												
Anas platyrhynchos	N												
Aythya nyroca	N												
Accipiter nisus	P												
Buteo buteo	P												
Circus aeruginosus	P												
Falco subbuteo	P												
Falco tinnunculus	P												
Perdix perdix	P												
Phasianus colchicus	N												
Gallinula chloropus	N												
Fulica atra	N												
Vanellus vanellus	P												
Tringa ochropus	P												
Larus canus	EV												
Lanus ridibundus	P												
Chlidonias hybrida	P												
Chlidonias niger	P												
Columba palumbus	N												
Streptopelia turtur	N												
Streptopelia decaocto	N												
Cuculus canorus	P												
Athene noctua	P												

N = Nesting P = Passinng migratory species WV = Winter visitor EV = Extraordinary visitor

Table 2

Species		Month 1	2	3	4	5	6	7	8	9	10	11	12
Strix aluco	P					—	—						
Asio otus	P			—	—								
Caprimulgus europaeus	N					—	—	—	—	—			—
Alcedo atthis	P						—	—					
Upupa epops	N				—	—	—	—					
Jynx torquilla	P				—	—							—
Picus viridis	N			—	—	—	—	—					
Picus canus	N			—	—	—	—	—					
Drycocopus martius	N					—	—	—					—
Dendrocopos maior	N			—	—	—	—	—					
Dendrocopos syriacus	P			—	—	—							
Dendrocopos minor	N			—	—	—	—	—					
Lullula arborea	P			—									
Alauda arvensis	P			—	—								
Hirundo rustica	P					—	—	—	—	—			
Delichon urbica	P					—	—	—	—	—			
Riparia riparia	P						—						
Oriolus oriolus	N				—	—	—	—					—
Corvus cornix	N			—	—	—	—	—					—
Corvus frugilegus	P			—	—								
Coloeus monedula	N			—	—	—	—	—					
Pica pica	P	—	—	—	—	—	—	—					—
Garrulus glandarius	N	—	—	—	—	—	—	—	—	—			—
Parus maior	N	—	—	—	—	—	—	—	—	—	—	—	—
Parus caeruleus	N	—	—	—	—	—	—	—	—	—	—	—	—
Aegithalos caudatus	N		—	—	—	—	—	—	—	—			—
Certhia brachydactyla	N		—	—	—	—	—	—	—	—	—		—
Troglodytes troglodytes	N	—	—	—	—	—	—	—	—	—	—		—
Turdus pilaris	WV	—											—
Turdus philamelos	N				—	—	—	—					
Turdus iliacus	P				—								
Turdus merula	N	—	—	—	—	—	—	—	—	—			—

Table 2

Species		1	2	3	4	5	6	7	8	9	10	11	12
		Month											
Phoenicurus phoenicurus	N				—	—	—	—					
Luscinia megarhynchos	N				—	—	—	—					
Erithacus rubecula	N	—			—		—	—		—			—
Locustella fluviatilis	N					—	—						
Acrocephalus arundin.	N						—	—					
Acrocephalus schoenob.	N					—							
Hippolais icterina	N					—	—	—					
Sylvia atricapilla	N				—	—	—	—					
Sylvia nisoria	P						—						
Sylvia borin	P					—	—	—					
Sylvia communis	P					—							
Phylloscopus trochilus	N			—	—	—	—			—			
Phylloscopus collybita	P			—	—	—	—	—		—			
Phylloscopus sibilatrix	P			—	—	—							
Regulus regulus	P			—									—
Muscicapa striata	P					—	—	—		—			
Muscicapa hypoleuca	P					—							
Muscicapa albicollis	P					—							
Prunella modularis	P				—								
Anthus trivialis	P				—	—							
Motacilla alba	P			—						—			
Motacilla cinerea	WV			—									—
Motacilla flava	P									—			—
Lanius excubitor	WV	—	—										
Lanius minor	P						—						
Lanius collurio	N			—	—	—	—						
Sturnus vulgaris	N					—	—	—					
Passer domesticus	P			—						—			—
Passer montanus	N			—	—	—	—	—	—	—	—	—	—
Coccothraustes coccoth.	N	—	—	—	—	—	—						—
Chloris chloris	N	—	—	—	—	—	—	—	—	—	—	—	—
Carduelis carduelis	N	—	—	—	—	—	—	—	—	—	—		

Table 2

Species		Month											
		1	2	3	4	5	6	7	8	9	10	11	12
Carduelis spinus	P	—	—	—	—								—
Carduelis flavirostris	WV	—	—										—
Serinus serinus	WV	—	—	—	—								
Pirrhula pirrhula	WV	—	—	—									—
Fringilla coelebs	N	—		—	—	—	—	—					—
Fringilla montifringilla	P			—	—								—
Emberiza citrinella	WV	—		—									—
Emberiza calandra	P				—								
Emberiza schoeniclus	P			—									

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CIRCULATION IN MATERIALS, INDUCED BY THE COLONY OF THE ROOKS (CORVUS FRUGILEGUS L. 1758) AT SASÉR, IN THE PERIOD OF REPRODUCTION

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(Received February 5, 1978)

Abstract

In the nature conservation area of Sasér, lying at Hódmezővásárhely, on the left-hand bank of the Tisza, between river kms 197—199, in a mixed heronry, on the average 2.000 pairs of rooks nested in the period between 1952—1977. The rooks have fledged, by pairs, two offsprings. In the average value of the statistics of 26 years, between 1 March and 31 May, the rook stock of the colony consumed 30,120 kg food. 53 per cent of this contained vegetable matters, 28 per cent invertebrates, and 19 per cent the remains of vertebrates. 9 per cent of the food mass originates from the flood plain of the Tisza, 91 per cent from the 2 to 15 km district of the nesting colony.

Introduction

The debate concerning rook feeding is of the same age as the literature of applied ornithology. The problem was cleared in European relation for a long time by the comprehensive monographs of VERTSE (1943), RASKEVITCH—DOBROVOLSKI (1954), PINOVSKI (1956, 1959, 1959a), OSMOLOVSKAYA 1972), and GRODZINSKI (1976.)On the basis of their results, the main nourishment of the rooks of mixed feeding consisted of agricultural insect pests and their ecological role proved to be positive in the overwhelming part of the year. This picture of feeding became, however, essentially modified in the overchemicalized agricultural environs of the last decades. Owing to the regression of the field insect fauna, the rook more and more consumes grown palnts and, at the same time, it becomes raptorial, damaging in this way game-preserving and nature conservancy. This unfavourable experiance has induced further investigations. It is known from earlier analyses that in respect of choosing food, the rook is extremely plastic. From tiny lymphs-larvae up to young hares, from small seeds upt to the coarse vegetable debris, it consumes everything. A large part of its food is supplied by the agrarian environment of monoculture character and poor in coenoses. Under conditions like this, the method of feeding-investigation striving for details becomes theoretic in its character. From production-biological point of view it is more expressive to base on quantity and proportions of larger food-groups. I was led by this point of view in drawing up my paper.

In the nature conservation area of Sasér, lying in the Tisza flood-plain at Hódmezővásárhely, in a 70 to 80 years old poplar plantation, a rook colony developed in a mixed heronry, in 1952. The ecological conditions and bird associations of the colony are detailed in my cited papers (STERBETZ 1972, 1975, 1977). The huge biomass of rooks raises the question, where the food of the bird of mixed eating is originating from and what nourishment groups it is composed of. I should like to answer these questions from the statistics of Twenty-six years.

Materials and Methiods'

In the period 1952—1977, I conducted the quantitative survey of the rook stock, on the basis of recording it more than once a year. From the mean value' of this I have obtained the value of 1994 pairs, brought up to 2000 hatching pairs (4000 individuals). For establishing the nestling mortality, during 26 years I have performed several surveyings and, by reason of this, I take into account two fledged young birds, for a nest each. [1]RASKEVITCH—DOBROVOLSKI, 1953, in the neighbourhood of Rostov, under similar conditions, had taken into account 2.2 progenies). For calculating the biomass, I have got a mean value 440 ind/gr, after weighing 50 adult individuals. The hatching weight of nestlings is about 12 gr, at taking wing, about 300 gr. To their staying at the nest for a month, I have calculated 160 grammes as a mean value, taking into consideration the unequa dynamism of their rapid development. In March and April, I took only into account the biomass of adult rooks, in May that of the adult and juvenile rooks. The number of nestlings in April is still unimportant, practically negligible. In the first days of June, the rook colony already disperses. The value of biomass is given by the product of the multiplication of the mean weight calculated for a single bird and the individual number established in the month in question.

The distribution on the foraging areas and the formation of the radius of action of rooks were solved by a car, following the bevies of birds, starting from the nesting communities in the small hours of the morning. The data forming the basis of calculations are here, as well, the mean values of 26 years.

At calculating the consumed food mass, there were evaluated in March and April only the biomass of adult individuals, in May, however, already that of nestlings, as well. The rooks, stayed at their alimentary areas from dawn until 10—11 o' clock, then from 15 o'clock until sunset. For getting saturated gastric contents, collections were always carried out in the late morning and evening hours. Because of the saturations two times a day, I always calcuated with the double of foodweight. I have multiplied this value with the individual number of rook quantity. The calculation of the foodmass of nestlings is complicated by the fact that their receptivity considerably changes every five or six days. At the beginning, the male is only feeding on 8 to 10 occassions. In about the third week, both parents already take part in bringing feeding stuffs and the number of feedings rises to 20 to 25. From the collections including the full period of the rearing of nestlings, a mean value was calculated in order to establish the average nestling foodweight. Calculating this value for two nestlings for each nest, I have multiplied it with the individual number of nestlings. The nestlings were always collected in the minutes following feeding, for the sake of getting saturated gastric contents. The daily foodweight falling on a single rook gave, in case of adult individuals, in March 70, in April 65, in May 65 gr mean values. In case of nestlings, the mean value in May was 50 gr.

I have to mention a possible fault at calculations and qualitative evaluations which is particularly important from practical point of view. The egg-destroying activity of rooks has been proved by a large number of observations all over Europe. But the degree of this cannot be demonstrated numerically. I have often observed in the rook colony of the Sasér, as well, that the rooks brought eggs of *Phasianus colchicus, Perdix perdix, Anas platyrhynchos, Fulica atra* and other unrecognizes eggs to their youngs. From the egg-shell debris accumulated below the nest or from the eggmass found in the gastric contents, anyway, the fact of occurrence could only be established.

I could not find any proper method for establishing the numerical amount of rook droppings either. According to JIRSIK(1952), among the omnivorous, very plastic rooks there occur sometimes some extremely specialized individuals which are, independently of the character of the feeding area, either extreme herbivores or carnivores. The formation of the weight and quality of the undigested food can be considerably influenced by composition and state of the matters taken in, the daily movement-intensity of birds, the trace elements taking place in the food, etc. Taking all these into consideration, in case of rooks, we may not expect generalizable results from weighing the products of any individuals held in captivity. At the fish-pond feed-mixture of domestic ducks consisting of vegetable matters, BALOGH (in: KANIZSAI—MITTELSTILLER 1969) calculated 5 kg excretion to 8 kg food. In case of wild-geese mostly fed with the vegetative parts of plants, KEAR (1963) calculated some values corresponding to 0.03—0.04 per cent of bodyweight for the daily excrete production in dried state. In case of insecti- and carnivorous birds, this value must be considerably lower. In this respect, however, there were not be available any literary data for me.

Results

The stock of the rook colony in the Sasér, in the average of the years 1957—1977, there were 2000 nesting pairs (4000 individuals), and for each pair two — altogether 4000 — fledged nestlings. The maximum value of the biomass in May was 2076kg. At the colony, in March and April there were only staying adult, but in May adult and juvenile individuals. In the first days of June the colony was dissolved.

The daily food requirements of rooks belonging to the colony were: in March 280, in April 260, in May 440 kg. This food requirement is in March 16, in April 14, in May 21 per cent of the biomass. The distribution of percentages is reflecting the increased food requirements of the developing nestlings. The dwellers of the colony consume altogether 20 120 kg food in the 92 day long reproductive period. 53 per cent of this foodmass is composed by vegetable matters, 28 per cent by invertebrates, and 19 per cent by the remains of vertebrates. A numerical demonstration of the destruction of a surely considerable amount of eggs was not possible.

The feeding action-radius takes place in the 2 to 15 km district of the nesting place. According to the Table containing the distribution of rooks, there originates only about 9 per cent of food from the flood-plain environment. 91 per cent originates from the agricultural areas lying outside the Tisza dams.

The excrete of the nestlings of the rook colony in the Sasér region, gets back in its full mass on the soil of the nesting site. A large part of the droppings originating from the afternoon food-intake of the adult individuals are also discharged in the nesting colony. The dropping mass originating from the gastrict contents filled in the morning, on the other hand, gets back into the environment generally far from the nesting colony, taking into consideration that the search for food then lasts for a longer time. The mass of the concentrated rook droppings, accumulated in the nesting colony, together with the excrete of heronds nesting also there, eradicates the vegatation. Its ecological part is, therefore, unambiguously negative.

The food mass, grouped and expressed in weight values, is referring to that the feeding of rook populations, concentrated in colonies, raises serious problems in the agricultural ecosystems or those standing under nature conservation.

References

JIRSIK, J. (1952): Prispevek k reseni vztahu havrana polniho (*Corvus frugilegus* L). k polnimu hospodarstvi a myslivosti. — I. Zoologické a entomologické listy *1/15*, 3.

GRODZINSKI, Z. (1976): Rooks, *Corvus frugilegus* L. in one of the Cracow Parks. — Acta Zoologica Cracoviensis *21*, 465—500.

KANIZSAI, GY.—MITTELSTILLER, J. (1969): Study on the breeding of broiler ducks on fish ponds. — Keszthelyi Agrártud. Főisk. Közl. *11*, 3—59.

KEAR, J. (1963): The agricultural importance of wild goose droppings. — Wildfowl Trust 14th Ann. Rep. 72—77.

OSMOLOVSKAYA, V. I. (1972): The feeding habits of rooks *(Corvus frugilegus)* and their ecological plasticity. — Bull. of Moscow Soc. of Naturalists. Biol. Ser. Moscow. *77*, 75—85.

PINOVSKI, J. (1956): Gospodarcze znaczenie gawrona *(Corvus frugilegus* L.). — Ekologia Polska Ser. B. Warszawa, *2*, 109—117.

PINOVSKI, J. (1959): Regelmäßigkeiten bei der Besiedlung der Saatkrähe *(Corvus frugilegus)*. — Verh. Intern. Pflanzenschutz Kongr. 1957, *1*, 40—45.

PINOVSKI, J. (1959a): Factors influencing the number of feeding Rooks *(Corvus frugilegus)* in various field environments. — Ekologia Polska, A. Warszawa 7, 435—482.

RASKEVITCH, N. A.—DOBROVOLSKI, J. B. V. (1953): Ob ekologii i znatchenii gratcha v usloviyakh khozyaystva osvoivsego travopolnuyu sistemu zemledeliya. — Zoologitcheski Zhurnal, Moskva *31*, 1241—1250.

STERBETZ, I. (1972): Die Vogelwelt der Reservate des Überschwemmungsgebietes der Theiß bei Hódmezővásárhely. — Aquila 1971—72. *78—79*, 45—80.
STERBETZ, I. (1975): Angaben zur Säugetiere und Fischfauna des Naturschutzrayons von Mártély. — Állattani Közl. *62*, 107—114.
STERBETZ, I. (1977): The Rook *(Corvus frugilegus* L.) in the nesting community of the heronry at Sasér. — Tiscia (Szeged) *12*, 141—144.
VERTSE, A. (1943): Verbreitung und Ernährungsweise der Saatkrähe sowie deren landwirtschaftliche Bedeutung in Ungarn. — Aquila, Budapest *50*. 208—248.

Table 1. *Formation of the stock of a rook colony the in Sasér area in the reproductive periods between 1952 and 1977*

Year	No of. rook pairs (III—IV—V)	No. of nestlings (V)	Biomas kg March	Biomas kg April	Biomas kg May
1952	1500	3000	1320	1320	1620
1953	2000	4000	1760	1760	2160
1954	2000	4000	1760	1760	2160
1955	2000	4000	1760	1760	2160
1956	2000	4000	1760	1760	2160
1957	2000	4000	1760	1760	2160
1958	2000	4000	1760	1760	2160
1959	3000	6000	2640	2640	3240
1960	3000	6000	2640	2640	3240
1961	3000	6000	2640	2640	3240
1962	3000	6000	2640	2640	3240
1963	3000	6000	2640	2640	3240
1964	3000	6000	2640	2640	3240
1965	3000	6000	2640	2640	3240
1966	3000	6000	2640	2640	3240
1967	3000	6000	2640	2640	3240
1968	3000	6000	2640	1640	3240
1969	3000	6000	2640	2640	3240
1970	3000	6000	2640	2640	3240
1971	500	1000	440	440	540
1972	400	800	c52	352	432
1973	500	1000	440	440	540
1974	400	800	352	352	432
1975	300	600	3ee	264	324
1976	100	200	88	88	108
1977	150	300	132	132	162
Average	1994 (2000)	3988 (400)	1751	1751	2076

Table 2. *Action-raFdiFus of rooks (km) and its distribution (ind/p. c.) in the feeding areas between 1952—1977*

Feeding area	March radius of action	March ind.	March p. c.	April radius of action	April ind.	April p. c.	May radius of action	May ind.	May p. c.
Grassland	15	2400	60	é5	400	10	7	200	5
Lucerne	10	800	20	5	400	10	5	400	10
Corn-sowing				8	1000	50	6	800	20
Maize-sowing				6	400	10	4	1200	30
Rice-plantation				5	400	10	4	200	5
Plough-land	10	800	20	6	400	10	3	200	5
Orchard							2	200	5
Flood-plain							2	800	20

Table 3. *Distribution in space and time of the rooks collected for feeding investigation (1952—1977)*

Collecting station	March ad.	April ad.	May ad,	juv.	Total
Grassland	20	10	10		40
Lucerne	10	10	20		40
Corn-sowing		20	5		25
Maize-sowing		10	5		15
Rice-plantation		10	6		15
Plough-land	20	10	5		35
Orchard			10		10
Flood-plain			10		10
Nesting colony			10	50	60
Altogether	50	70	80	50	250

Table 4. *Mean values of the daily food requirements od a rook colony in the Sasér area in the months* March-*April*-May *(1952—1977)*

Kind of food	Adult rooks in March kg	p. c.	in April kg	p. c.	in May kg	p. c.	Juvenile rooks kg	p. c.	Total food in May kg	p. c.
Vegetable matters	196	70	170	66	96	40	60	30	156	36
Invertebrates	56	20	64	24	72	30	80	40	152	35
Vertebrates	28	10	26	10	72	30	60	30	132	29
Altogether	280	100	260	100	240	100	200	100	440	100

Table 5. *Food requirement of a rook colony in the Sasér area, monthly and summarized in the period of reproduction*

Kind of food	Adult rooks in March kg	p. c.	rooks in April kg	p. c.	rooks in May kg	p. c.	Juvenile rooks in May kg	p. c.	There-monthly total food amount kg	p. c.
Vegetable matters	6076	70	5070	60	2976	40	1860	30	15 982	53
Invertebrates	1736	20	1950	24	2232	30	2480	40	8398	28
Vertebrates	868	10	780	10	2232	30	1860	30	5740	19
Altogether	8680	100	7800	100	7740	100	6200	100	30 120	—

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DATA ON THE BIRD STOCK OF THE FLOOD-PLAIN AT TISZAFÜRED

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Abstract

We have performed stock-taking within th framework of the Third Ornitholoigcal and Nature Conserving Camp of the Hungarian Ornithological Association, in the area of the Bird Reserve at Tiszafüred and the Angler Island. In the Bird Reserve, work was concentrated on the heronry and its wider environs. It was established that in the colony seven species were hatching, namely: *Phalacrocorax carbo, Ardea cinerea, Ardeola ralloides, Egretta alba, Egretta garzetta, Nycticorax nycticorax,* and *Platelea leucorodia,* with a total of 1149 pairs. In the Angler Island, apart from establishing the number of nesting pairs, we strove to clarify, in what kind of niche the single species were living in the area. Taking into consideration the short period of observations, I have intended this publication to be a fact-communicating work.

The Hungarian Ornithological Association organized its Third Ornithological and Nature Conserving Camp on 21—28 June 1977 at Tiszafüred, among others with the aim of carying out ornithological observations in the area of the Tisza II Reservoir and the Hortobágy National Park. The fact-finding work, important for the Tisza research, took place in the area of the Bird Reserv - at Tiszafüred and on the Angler Island. As the ornithological survey in 1969 did not affect these two areas (LEGÁNY 1971) and as I have not found any data relating to these in the literature of the present-day Tisza research, either, I mean to be worth, and even necessary, to publish the recent results.

Materials and Methods

As the time at our disposal has not enabled any deeper and comprehensive ecological analysis to be performed, apart from fixing the species quantitatively and qualitatively, we have investigated into the distribution in both areas, on the basis of the nesting and feeding districts. This was important if only because one of the objects — the Angler Island — is a relatively disturbed, much frequented area, with but a few trees, while the Bird Reserve at Tiszafüred is less disturbed, having more forest plantations and a huge heronry. The character, vegetation and extent of the areas are also different and this also involves the difference in ornis.

Results of observations

The Bird Reserve at Tiszafüred:

It is the area of the Tisza II Reservoir, lying north of the railway line between Tiszafüred and Poroszló. It is mostly covered with plough-lands but there are also meadows and grasslands of large extension, as well as poplar and white willow plantations to be found in the area (sketch map 1). The centre of our observations was the heronry and its wider environs in the flood-plain at Poroszló because, apart from Imre Lipcsey's oral indications, we did not know any details of it.

The colony developed in a white willow plantation, on about 4 to 5 hectares. On the occasion of the survey, 1149 nests were counted, from the following species.

	pairs	per cent
Phalacrocorax carbo	6	0.52
Ardea cinerea	42	3.65
Ardeola ralloides	16	1.39
Egretta alba	33	2.87
Egretta garzetta	205	17.84
Nycticorax nycticorax	846	73.62
Platalea leucorodia	1	0.08

In connection with the colony, there are some things worth mentioning. One of these is the structure of the heronry. The other species settled among the night herons, coming to 73.62 per cent, in larger contiguous islands (Fig. 2). And even, in the middle of the colony, the settlement of night herons is also much denser. *Ardea cinerea,* in opposition to the *Egretta* and *Ardeola ralloides,* do not form any closed groups but they hatch uniformly scatterred in the heronry.

All the nests were, without any exception, on willows. The heronry did not expand towards the two adjacent poplar plantations. At the date of the survey, there was 50 to 80 cm water below the colony, continuing to cover the soil, in a changing thickness, for the whole year. A specific matter of curiosity of the heroncy is the populous group of *Egretta alba* nesting on tress. In the willowy containing the colony, there couldn't be found any warblers. We have only observed three *Fringilla coelebs* individuals in the adjacent poplar plantation.

There was found one nest each of *Podiceps cristatus* resp. of *Fulica atra,* not as members of the heronry but quasi under its "protection" — "parish" — in the wood. The wood was bordered from the north with a moist marshland with bulrush in which there were observed *Anas platyrhynchos, Spatula clypeata, Aythya nyroca,* and *Acrodephalus scirpaceus* species.

In the shallow water of the mortlake, bordering the plantation from the west, eight *Ciconia nigra* individuals were feeding. This species has supposedly some nests in the area of the Bird Reserve, as well, but they could not be found. On the other hand, we have found an inhabited nest of *Milvus migrans,* and this counts as a welcome datum, taking into consideration the rapidly decreasing number of this species. According to our observations, the overwhelming majority of the dwellers of the heronry went for their food into the puddles and mortlakes in the area of the Bird Reserve.

It is regrettable that the liquidation of the wood containing the heronry, as well, is scheduled. The continuance of the heronry of very great value, belonging to the area of Hortobágy National Park (!) is endangered. In our opinion, this plan were to be changed and the ornithologically so valuable and interesting colony should obtain full protection.

The Angler Island at Tiszafüred:

It lies close by the community, in the semicircle of the mortlake bending towards north with its two arms. It is an area utilized mostly as a grassland, although there are some imposing white poplars and willow-bushes in the grassland, as well, and mainly at the banks of the mortlake. The riverside strip of the mortlake is bordered with *Phragmites communis* and *Typha angustifolia.* All these neable — in spite of the disturbance caused by angling and some camping — a rather colourful bird association to be formed.

Table 1. *Bird species observed in the Angler Island at Tiszafüred.*
(The numbers denote the quantity of nesting pairs, +denotec the species only feeding there)

Species	Reed-fringe	Waterside trees and bushes	Trees, shurbs in the meadow	Meadow
(1) *Ardea cinerea*	+			
(2) *Egretta garzetta*	+			
(3) *Anas platyfhynchos*	+			
(4) *Phasianus colchicus*				3
(5) *Crex crex*	+			
(6) *Streptopelia turtur*		1	3	
(7) *Cuculus canorus*		2	1	
(8) *Picus viridis*		1		
(9) *Dendrocopos maior*			1	
(10) *Oriolus oriolus*			2	
(11) *Corvus cornix*		1		+
(12) *Pica pica*				+
(13) *Parus maior*			2	
(14) *Luscinia megarhynchos*			1	
(15) *Acrocephalus scirpaceus*	1			
(16) *Acrocephalus schoenobaenus*	9			
(17) *Sylvia atricapilla*		1		
(18) *Sylvia nisoria*			1	
(19) *Sylvia borin*		2	2	
(20) *Sglvia communis*			3	
(21) *Muscicapa striata*			1	
(22) *Lanius collurio*			3	
(23) *Sturnus vulgaris*		2	3	+
(24) *Passer domesticus*			3	+
(25) *Passer montanus*	2	2		+
(26) *Chlorsi chloris*		1		
(27) *Fringilla coelebs*		2	2	
(28) *Emberiza citrinella*				1
(29) *Emberiza calandra*				2
Number of nesting species	2	10	15	3
Number of nsting pairs	10	15	29	6

With regard to the extent of the area, the survey of stock was carried out divided into four strips. In every strip a separate survey group was going forward, recording the data observed according to uniform instructions. We strove to establish what kind of species were nesting in the area and in what proportion. Moreover, it was to be established, in what kind of niches they lived in this diversified scenery and what bird species were visiting the area only for getting food exported in this way. The results obtained are shown in Table 1.

82.75 per cent of the observed species are feeding and hatching in the investigated area. 17.24 per cent of them are only feeding there. These are, at any rate, species of large body, consuming a large quantity of food.

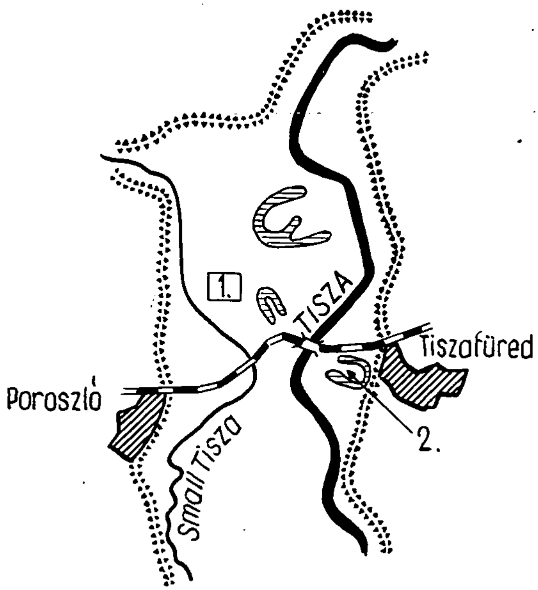

Fig. 1. Geographical situation of the investigated areas in the flood-plain of the Tisza

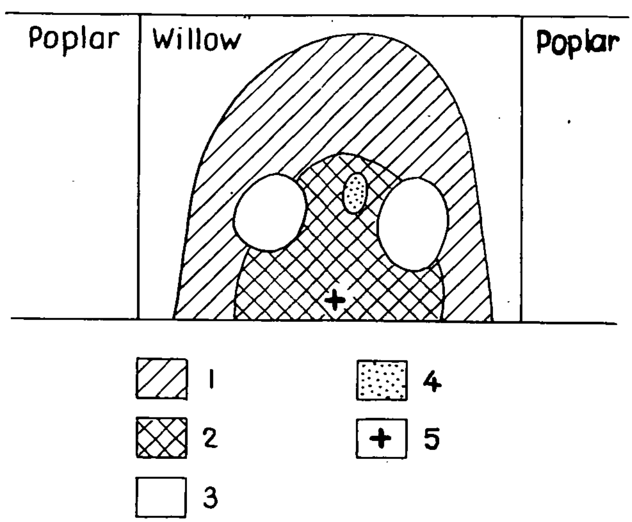

Fig. 2. Structure of the heronry of the Bird Reserve at Tiszafüred

(1) (1) Rather sparse colony of *Nycticorax nycticorax*
(2) Rather dense colony of *Nycticorax nycticorax*
(3) *Egretta alba, E. garzetta, Ardeola ralloides*
(4) *Phalacrocorax carbo*
(5) *Platalea leucordia*

The large mass of the nestlers — 58.33 per cent — so formed by insectivorous singing-birds of small body. Herbivora represent 25 per cent and omnivora 16.67 per cent. This comparatively considerable richness can be explained partly by the abundance in food, partly by the manysided nesting possibilities — reed, soil, shrub, treetrunk, and the level of leady crown (tree stratum).

In conclusion, I should like to make it clear that the present publication was first of all made with the intention of publishing data. The short time at our disposal and, as a result of this, the low number of not repeated observations do not enable particular conclusions to be drawn. The data themselves, however, seem — as referred to in the Abstract — to be suitable for being published.

References

BALOGH, J. (1958): Lebensgemeinschaften der Landtiere. Budapest—Berlin.

SZÉKESSY, V. (1958): Magyarország állatvilága. (Fauna of Hungary. Aves). Budapest.

LEGÁNY, A (1971): Data on the ornithological conditions of the inundation area Tiszafüred—Kisköre. Tiscia (Szeged) *6*, 41—55.

LEGÁNY, A. (1975): A fészkelő madárközösségek szerepe a Felső-Tisza árterének biotópjaiban (Role of nesting bird associations in the biotopes of the flood-plains in the Upper-Tisza Region). Cand. thesis. Manuscript.

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EFFECT OF THE ANTHROPOGENEOUS POLLUTION ON THE TISZA AND ITS TRIBUTARIES

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Abstract

In the watershed area of the Tisza there is first of all performed an agricultural activity polluting the water. The limnological character of the river is formed in a negative character by the chemical substances washed into, the considerable content of matter in suspension and bacteria.

The situation of dead arms is unfavourable, in many cases catastrophic· Our natural values are on the brink of ruin because of the proliferation of the phytophagous fish in the dead arms.

The Tisza is touched by the effect of industrial pollution mainly by means of the tributaries.

Not more than about 5 to 6 per cent of the urbanization sewage waters get into the rivers in a cleared state. According to the water quality investigations performed by means of biological methods, in the last decade the water of the Tisza only deteriorated in the lowest stretch. According to the bacteriological investigations, on the other hand, in the Lower Tisza Region, the hygienic quality of water bacame worse by 1 to 2 categories of late years.

The pollution of river waters can considerably be reduced by keeping in operation some water purification equipments.

This paper is reporting on some data from among the investigations of the Tisza-Research Working Committee. Apart from the authors whose names are given in the title, there were co-operating in the compilation: I. BANCSI, Mrs. I. BANCSI, K. BÁBA, GY. CZISMAZIA, MÁRIA CSOKNYA, Mrs. L. DOBLER, Á. FARKAS, J. HAMAR, Á. HARKA, MÁRIA HEGEDŰS, Mrs. Z. KEMENES, K. KISS, A. SZABÓ, A. VÁNCSA, P. VÉGVÁRI.

Introduction

The effect of the interventions influencing the life of rivers most obviously manifests itself where the natural course of the river was transformed by man (canalizition barrages, etc.) or where several industrial and agricultural establishments were set up beside the water. The same holds good considerably in respect of the Tisza and still more in that of its tributaries.

In the watershed area of the Tisza first of all an *agricultural* activity is going on, polluting the water in most part of the year and along the whole stretch of the rivers. The water deterioration manifests itself both in chemical and in biological relations.

The food content of the water is increased by the chemical substances (fertilizers, insecticides, pesticides) of agricultural origin which were washed into the water. The high floating-matter and bacterial content originating from these determines the limnological character of the Tisza.

Between the flood and summer low-water periods of the river there is a considerable difference. At flood, the conveyed float prevents a richer plankton from coming into being. Thus only the quantity and activity of the bacterial planktons is considerable.

At low water, the plankton activity increases; in the stretches before the river barrages the measurement of the primary production refers to a water of eutrophic and even sometimes hypertrophic state. The water of the river is rich in inorganic food materials (nitrogen, phosphorus). In this way, if the floating matter settles down, the phytoplankton always achieves the maximum growth, corresponding to the temperature.

After creating river barrages, the original state characteristic of the river changes: the clearing ability of the water decreases, the danger of eutrophisation increases. As a result of storage, a large quantity of float can be deposited. The salt content of water may increase what is unfavourable for irrigation. At making reservoirs, a meticulous care is, therefore, to be taken in removing the land-vegetation and — by preventing stagnant waters from coming into being — in avoiding the formation of marshlands.

The effect of tributaries is considerable. Their pollution is increasing, in the low-water periods they are in a eutrophic state. For instance, we refer to the change in the degree of trophity of the Sajó water between the years 1965 to 1976.

In the Sajó some phytoseston communities referring to a eutrophicated river state are to be found.

The seasonal change in all the values of a million order— particularly in some sections of the bed stretch below Miskolc — can be characterized by a curve of the course of double maxima: the winter minimum is followed by a spring maximum and then by a very strong autumn maximum.

For characterizing the change in time, the comparison carried out on the basis of average values is the most suitable. In the year 1976, in the bed stretch before the mouth, the effect of the double-mouth of Hernád manifested itself most definitely. Accepting as a limit the value $1 \cdot 10^6$ individual/litre, the Sajó can generally be characterized by the trophity below the eutrophic level. This only rises above the eutrophic level in the reaches before the mouth.

On the basis of the maximum values of the phytoseston, in the years 1974—1975—1976, it exceeded the eutrophic level in the whole bed stretch considerably. It is remarkable that below the double mouth of the Hernád the minima are also significantly greater than in other stretches.

It is unambiguously indicated by the changes in the longitudinal section that the trophity of the Sajó increases in the bed stretch below Miskolc and is sudden in the stretch before the mouth.

The increase in trophity is, of course, harmful to the water quality of the Tisza, as well. The trophity of the Sajó is, therefore, to be reduced by moderating the amount of the allochthonous materials.

From among the biological pollutions, the phytophagous fishes are to be emphasized particularly. The so-called phytophagous fish species introduced into the fisheries of our contry in the last decade are today already regular catches of the fishers in Szeged. 10 per cent of the fishes caught in 1976 is given by *Hypophthalamichtis molitrix,* 0.5 per cent by *Chtenopharingodon idella. Hypophthalamichtis nobilis* was caught but rearly. These may have been individuals escaping from the fisheries, resp. in case of *Hypophthalmichthys molitrix*, and *(Ctenopharyngodonidella)*, descendants of the individuals strayed away and acclimatized. It is to be accepted as a fact that the latter two species spawn in the Tisza, resp. in its dead arms.

Their harmful effect has not manifested itself, as yet, in the flowing Tisza, all the more in the Tisza dead arms. The situation of the ox-bow lakes of the Tisza is, from this point of view, unfavourable, often catastrophic. The floating and the river-side vegetations of the Dead Arm at Tiszafüred and of the Dead Arm at Körtélyes, belonging to the Region-Conservation District Mártély-Sasér were fully exterminated in 1976 by the Ctenopharingodon idella having got there in a major quantity.

The dead arms drawn in this way into the hatching of fish become ruined fast while the production achieved with a small investment is only temporary. But the vegetation, belonging to the characteristic landscape and destroyed, cannot be reconstructed at all or only with a long and expensive work. The region-conservation districts, nature conservation areas should therefore be protected from the invasion of these fish species.

The effect of the industrial pollution is considerable in the tributaries, as well. The Kurca is an example for this.

The Kurca, flowing into the Tisza below Mindszent and being, in its present state, of dead-arm character, is a reservoir of inland and irrigation waters. The quality of its water at the main site of water removal (at Magyartés) in is any case suitable for irrigation (its dissolved salt content is 200—350 mg/l, the value of Na p. c. is between 23.8—44.8). Above the town Szentes the water quality is strongly deteriorated. (The dissolved salt is 580—950 mg/l, Na p. c. 44.7—57.2). This deterioration manifests itself below the town still more intensively. (Its dissolved salt content is 670—1000 mg/l, Na p. c. 67—75.4). At Szegvár, the water of the Kurca can already be used for irrigating only in case of a water improvement by dilution.

The quality of irrigating water grows, therefore, weaker as going down the Kurca. The high degree deterioration follows, first of all, as a result of the thermal waters. At present, about 24.000 l/sec water of fifteen thermal wells is getting into the main channel Kurca. Its damaging effect presents itself primarily as a result of the high Na^+ percentage and the dissolved salt content. There may incidentally occur some heat pollution, as well. (The water of high temperature is harmful to the aquatic zoobenthos not only owing to its degree of temperature but also inducing anoxia in the water by reducing the solubility of gas).

The main damaging effect presents itself in the high dissolved salt content of the thermal water. The fresh-water living world of the surface water courses which take up the thermal waters is strongly damaged by the increase in salt content. By this the fish even becomes unfit to eat. Daily 54.1 t salt content gets into the taking-in water course. This salt of discouraging amount will increase after the thermal well-boring, projected for the next future.

Today it is no more sufficient, only to observe and register the environmental pollution of the Kurca — and through it that of the Tisza — but a concrete intervention is also needed.

The pollution of the Tisza water by *urbanization* was increased strongly by the acceleration of the urbanizational processes taking place in the recent years. Therefore, and taking also into consideration that about 95 per cent of the sewage-waters of urbanization gets into the Tisza without being cleared, the evaluation of the water of the river according to water quality is very important. For rendering perceptible the quantity of extraneous materials getting into the Tisza, it is to be mentioned that at Szeged, only from the town, 40 to 43 thousand cc.m sewage water gets into the river a day.

The results of the biological and bacteriological investigations are not quite identical.

According to the biological investigations, the water quality of the Tisza changed in the recent years (1974—1976) hardly.

The halobity of the river was only examined by measuring the electrical conductivity, as well as the quantity of the eight main ions dissolved in the water. With this method, it could only be registered that the river leaving our country has been characterized by the Ca—Mg, resp. HCO_3—SO_4 ions for a period of more ten years.

By comparing the values of the competent saprobity index, it could be established that the pollution of the river from Csongrád down to Tiszasziget has not increased since 1974. At Szentes, first class water quality was found in all three years. Below Csongrád, too, the water is generally clean, that is to say, the Kőrös flowing into the Tisza there brings clean water. At Mindszent, the results of the saprobiological investigations do not reflect the deterioration of water quality which can easily be demonstrated from the bacteriological examinations. Getting to the border of the country, the Tisza leaves the country already with the pollution of the town Szeged and becoming united with the Maros, without changing its category but, at any rate, with a verifyable deterioration of the water quality.

Toxicity has not been investigated with test method. Zooplankton count was performed in 1975—1976. It is proved by the result of this that from Csongrád to Tiszasziget the zooplankton stock of the river was not damaged.

The examinations concerning the trophity of the river were completed, in addition to determining all the algae i/l, with the quantitative determination of chlorophyl, the total bacterial count, and from foodstoffs, with the quantitative determination of phosphorus and nitrogen. On the basis of surveying the results, the changes having affected our river since the river barrages at Tiszalök, Kisköre, resp. Óbecse had been built can be recognized unambiguously. In 1974, the highest total algal count was found in October (5 million i/l). In 1975, similarly in October, under approximately identical hydrological conditions, the algal count increased to 19 million i/l. In 1976, the highest value, 39 million i/l, could already be measured in August.

The trophity of the river legs still far behind the data of the eutrophic-polytrophic stagnant water. But the lineal rise taking place in the recent years calls the attention to that the possibility of loading the river with organic materials and changing the hydrological conditions is limited.

According to the bacteriological investigations, on the other hand, the quality of the Tisza water considerably deteriorated in the years 1974 to 1976.

The conditions of water quality in county Csongrád developed as follows:

In 1974, from Csongrád to Tápé, the water was of category II (a little polluted). In the reaches below the town Szeged (Tiszasziget, border of the country) it belonged to category III (polluted) what may probably have been caused by the uncleaned sewage water led into it here.

The water quality of the Maros was of category II in this year.

In 1975, the hygienic water quality of the Tisza generally deteriorated one class: it belonged to category III. The cause of this may supposedly have been the Kisköre Water Barrage. Its beginning to operate altered the microbiological conditions of the river.

The Maros belongs to category III.

In 1976, the Tisza till the area of the town Szeged and the water of the Maros are of category III. From Szeged down to the border of the country it is of category IV (strongly polluted). The deterioration of the water quality of this stretch has probably been induced by the Törökbecse (Novi Bečej) river barrage which — reducing the speed of water considerably — has an unfavourable effect on the biological equilibrium of the Tisza.

The incidence of pathogenic bacteria has also increased in the water of the Tisza. In 1976, in the longitudinal section of county Csongrád — expressed in the percentage of the average positivity — it was 55.8 per cent. On the basis of the MSZVH—OVH — National Water Office sectoral standard-project, the percentage given surpasses the allowed percentage of incidence.

The consequences of the anthropogeneous pollution can be observed on the most various organisms of the zoobenthos of rivers. The organisms living in water are, of course, exposed to this effect in a higher degree than those living on the dry land.

The algal vegetation often designates water pollution with the phenomenon of algal bloom ("efflorescence of the Tisza"). The water of the Dead Arm at Mártély was already stained several times by the algal blooms of the Euglenophyte species and the efflorescence of *Eudorina elegans*, endangering also the recreation area.

Investigating the extreme resistance of *Eudorina elegans*, the following may be established.

This alga is a highly tolerant species. Its water bloom was observed in strongly polluted waters, and in those of polysaprobic and α-mesoapprobic characters. *Eurodina elegans* is, according to Pascher (1927), of β-mesosaprobic, andaccording to Huber—Pestalozzi (1961) of oligosaprobic character. We were moved by these extreme values to investigate, in part experimentally, the tolerancee-conditions of *Eudorina elegans*.

During the algal bloom of the Dead Arm at Mártély in 1973, the plankton samples in the habitat water remained undamaged for the longest time. The fermenting dung water used as a polysaprobic nutritive medium exerted a damaging effect on the organisms but in different degrees and at various dates. In the nutrient solution of 12,000 mg/l total salt content, as well as in the saltyalkaline (sodic) water the destruction followed similarly at different dates. The initial signs of desorganization manifested themselves at some organisms but in the third week. In the salt solution diluted in 1 to 2 ratio with the water of the dead arm, the damages often appeared still later. Dung water added to the litre of the saltysodic water in a quantity of 10 ml played the part of a nutritive solution in which the *Endorina* thalluses were rather only deformed and its cells have sometimes not or but later preished. In this case, the polluting dung water exerted almost a "protective effect" on the single colonies. It could generally be observed that in tolerating the great concentration, alcalinity or pollution the single colonies are not quite idenical, and even sometimes they considerably differ from one another.

In respect of these great extremities, *Eudorina elegans* may be named an eurytopic organism.

The decline of almost catastrophic extent in the stock of *Palingenia longicauda*, taking place in the last decade, was caused — apart from the large floods in the time of swarming — by the water pollution and the dropping of water speed the siltation owing to the construction of water barrages. And the decrease in the may-fly population brought about the rapid diminution in the amount of *Acipenser ruthenus*, the main food of sturgeon having been the Ephemera species.

It was demonstrated by our benthos investigations that in the mouth district of sewage drains in the Tisza a considerable decay follows in respect of the invertebrate bottom-dwelling animals which have a very important part in the self-purification of the river.

In the river stretch above Szeged, kept still in evidence as a natural biotope, the individual number of Anelida, Mollusca, Ephemeroptera, Diptera: Chironomidae, calculated for one square metre, is 5300/sq.m. From this, the individual number of Mollusca is 1300/sq.m.

From Mollusca, the snail species *Lithoglyphus naticoides* and the shell species *Dreissena polymorpha, Pisidium amnicum, Unio crassus* are dominant.

In the samples taken in 1—300 m after the sewage drains, the species and individual numbers of the above taxonomic categories fall to 640—2600/sq.m. The quota of Mollusca has increased but the shells important in the water filtration disappeared.

The benthos can be protected from this decay to a certain extent if the sewage water, even the purified one, is led into the middle of the river.

The disturbing human influence exerted on the terrestrial ecosystem often befalls the living world of the flood-plain by the means of dams. An example for this is the road-building on the top of the dam from the bridge at Algyő up to the Tisza Dead Arm at Atka. The bitumen of low melting point used for surfacing the road became flowing under the influence of the glare of the sun and hundreds of the tiny mammals got stuck in it and perished. In a km long stretch, we have counted on average 500 to 550 individuals from the following species: *Microtus arvalis, Mus musculus, Apodemus sylvaticus, Apodemus agrarius, Micromys minutus, Sorex araneus.*

As a result of the pollution followed on the dam, therefore, in the animal life that was enriched in the fringe-coenosis of the flood-plain, the biological equilibrium was lost what may have far-reaching further harmful consequences in the course of the whole food-chain.

The pollution of river waters, reservoirs can considerably be decreased with *water-purification plants.*

The sewage filtering lake system of the Tisza Integrated Chemical Works consists of six lakes of 1.5 m depth. Their total surface is 18 ha. Water remains in the lakes about 50 days long. 4,500 cc.m/day mechanically and biologically purified sewage water pour into them. The quality of the purified sewage water generally reaches the standard prescriptions. The value of KOI_{Cr} is 60—100 mg/litre. The dissolved salt content is medium high: 500—800 mg/litre. The total mineral N-content is 2—10 mg/litre. The total P-content changes between 1—3 mg/litre.

It is to be established that the more or less decomposed organic materials, the mineralized vegetable nutritive matters can be decomposed on in the post-purifying lakes or extracted from the water in case if in the lakes a fixed plant stand comes into being and is kept at an optimum level, by being treated and thinned adequately. The extent of repurification is increased by the rich animal stock of lakes. A part of these (Insecta) fly out of the water, another part get into the body of fishes bred in the lakes as fish-food. The amount of organic matters getting into the Tisza will be decreased with these, as well.

On the basis of the experiences so far, we propose to bring about similar repurifying lake systems.

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ON THE ACTIVITY OF THE TISZA-RESEARCH WORKING COMMITTEE IN 1977

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The activity of the Tisza-Research Working Committee, established twenty years ago, in 1957, has continued in the framework of the subject entitled "Complex research into the Tisza and its flood-plain, with regard to the river barrages and nature conservation areas", consented to by the Hungarian Academy of Sciences.

The research work belongs to the detail-task named "(2), (3) Research into the water ecosystems", connected with the international programme "Man and Biosphere" within the main direction "Protection of man and his natural environment (biosphere)" in the 15-year long-range plan of the Hungarian Academy of Sciences.

The research — apart from the investigations performed along the whole stretch of the Tisza is Hungary — has mainly been carried out in the three places qualified as the most important ones in conformity with the social claims.

1. In the district of the Tisza II River Barrage and Reservoir at Kisköre.

Filling up the reservoir-lake begins in 1978. There were elaborated therefore the salt output — water output interrelations by means of which continuous information could be obtained about the salt-flow of the water supplying the reservoir.

The effect of the herbicides, planned for removing the vegetation to be found at present in the bed of the reservoir, exerted on water organisms and the bottom sediment, was analysed in a field model experimentation.

It was demonstrated that even the increase in water level carried out so far (meaning only the full filling of the Tisza bed) increased the individual number of Oligochaetae in the benthos, and that was a favourable change from the point of view of fish feeding.

The dynamics of the development of the fish stock is pointing at the direction of the impoverishment of the fauna. On the other hand, *Carassius auratus gibelio* became very numerous, explosion-like.

The surveying of the heronry formed in the flood-plain of the district (probably the largest heron colony along the Tisza) was carried out.

Our mesoclimate measuring stations functioning at Sarud and Tiszaszöllős have supplied their data continuously.

A co-worker of ours in the Tisza II Laboratory at Kisköre has functioned as a unit of our Working Committee.

2. In the area of Körtvélyes isle (Region Conservation District at Mártély-Sasér).

The bacteriological investigation into the dead arm at Körtvélyes has demonstrated the poisoning effect of the sewage-water having got into the water mass and its algological research that of pesticides. The zooplankton investigations have established that in the summer months the water quality more and more deteriorated and the number of mesosaprobic organisms considerably increased. The damaging effect of water-pollution equally manifested itself in both the plant and animal kingdoms. At the suggestion of our Working Committe, supported by the National Water Office, the Water Management of the Lower Tisza Region prepared the plan of a canal for relieving the dead arm from sewage-water.

It was demonstrated by the investigations, performed in the marshland of the flood-plain in the field of the connections between stock structure and organic-matter production, that after prolonged water coverings, from among the meadow associations the regenarion of Tiphoides arundinacea stocks was the slowest one. In case of nearly identically closed and high associations the dry-matter production above the surface of the earth is the larger the more homogeneous the stock is.

It was ascertained that the herbivorous fishes (Ctenopharyngodon idella and Hypophthalamichthys molitrix), considerably multiplied in the dead arm at Körtvélyes, eradicated the water and riverside vegetation and endanger the survival of the indigenous fish stock. Our working committee presented a suggestion to the competent organs, calling their attention to the harm caused by these fish species.

In the hollows of bird colonies in the Canadian poplar plantations bird-bromatological investigations were performed with the aim to clear up the part of hollow-dwelling birds in re-establishing the disturbed biological balance of the wood.

Base I was working on Körtvélyes isle, as a storage place and quarters. The climatological and entomological data were supplied regularly by the mesoclimatic measuring station and the light-trap for collecting insects, laid in the district.

3. In the area of the intended Tisza III River Barrage and Reservoir (at Csongrád).

The dead arm at Lakitelek belonging to the Kiskunság National Park and the wood Tős-erdő lying beside it survived in a natural enough state and is, therefore, suitable to reconstruct the relations having existed before the Tisza control. The investigations of the Tisza-Research Working Committee — apart from fixing the present-day state — are preparing the reconstruction of the region.

The general geographical survey of the area has been taken.

The water-chemical investigation of the dead arm at Lakitelek demonstrated that the southern section —Tős-erdő — was somewhat polluted by the social outlet water of Tős-erdő-Fürdő; the northern section, however, was clean.

Taking botanical surveys extended to three wood associations.

It was proved by the exposure of the ecological conditions of the bird stock that the fluctuation of water level exerted a selective effect upon the terricolous nesting species.

Base II set up in the Tős-erdő worked during the year well.

4. Other Tisza sections.

The fortnightly longitudinal section investigation, performed with the support of the National Water Office and the Water Management of the Middle Tisza Region in the whole Tisza stretch in Hungary, supplied considerable data to the knowledge concerning the water bodies passing down the Tisza. And the study-tour in the Jugoslav stretch of the Tisza prepared the longitudinal section investigation of the next year, expected to continue until the mouth of the river.

The elaboration of the Syrphida collection made of the whole Hungarian stretch of the Tisza has been finished.

We have succeeded in clearing up the problem of the course of stocking the plantations of the Tisza valley with Mollusca.

It was established by the survey of the Riparia colonies of the Lower Tisza Region that the stock — after a regression of several years — is a little increasing again.

In the field of the aetological investigations, the sonogram-like analysis of the alarm-call of water birds began.

In addition, there was an investigated area the Maros, the Sajó, and the Eastern-Main Channel, as well.

In 1977, 48 researchers worked in the Tisza-Research Working Committee. (From these, 20 were dealing with hydrobiology, five with botany, 21 with zoology, two with natural geography).

Vol. XII of the Tiscia, in which the co-workers exposed the results of their investigations in 18 monographs, is just published.

Further eleven papers were published in University and Museum yearbooks.

In the Eighth Tisza-Research Conference on 22—23 April, the members of the Committee reported in 22 lectures on the result of their research work of the previous year. The participants discussed, these lectures in approximately sixty contributions.

The decisions, suggestions formed in the Conference were sent to the competent institutions. The summary of lectures has been published.

Further thirteen lectures were delivered by our research workers in various professional home programmes of scientific and practical directions. Two lectures were delivered abroad.

In the course of the year, one of our co-workers was qualified for a candidate's degree, with a Tisza-Research theme. Two others presented their theses for getting a candidate's degree, and further three made university doctoral theses.

The library, containing several hundred valuable home and foreign publications, obtained mostly in exchange for the Tiscia, and dealing with waters and their environment, continued developing considerably.

In the flood-plain areas, approachable only in water ways, the small boat named "Kolokán" served research work with good results.

There was made a detailed report of the research work to the Hydrobiological Committee of the Hungarian Academy of Sciences, and of the nature conservation activity to the Botanical Committee of the Hungarian Academy of Sciences.

A Tiszakutató Munkacsoport 1977. évi tevékenységéről

DR. MARIÁN MIKLÓS

MTA Tiszakutató Munkacsoport, Szeged

A húsz éve, 1957-ben megalakult Tiszakutató Munkacsoport működése a Magyar Tudományos Akadémia által jóváhagyott „A Tisza és hullámterének komplex kutatása, tekintettel a vízlépcsőkre és a természetvédelmi területekre" című téma keretében folyt.

A kutatómunka a MTA 15 éves távlati tervében „Az ember és természeti környezetének (bioszféra) védelme" című főirány „2., 3. Vízi ökoszisztémák kutatása" elnevezésű részfeladatához tartozik és a „Man and Biosphere" nemzetközi programhoz kapcsolódik.

A kutatás, amellett, hogy a Tisza egész hazai folyása mentén végeztek vizsgálatokat,legfőképpen azon a három helyen folyt,amelyeket a társadalmi igényeknek megfelelően súlyponti területeknek minősítettek.

1. A kiskörei, Tisza II. Vízlépcső és Víztároló körzetében.

A tároló-tó feltöltése 1978-ban megkezdődik. Ezért került sor olyan sóhozam-vízhozam összefüggések kidolgozására, amelyek segítségével folyamatos inormáció nyerhető a tárolót tápláló víz sóforgalmáról.

A tároló mederben jelenleg található növényzet eltávolítására tervbevett herbicidek a vízi szervezetekre és a fenéküledékre gyakorolt hatását szabadtéri modellkísérleteken analizálták.

Kimutatták, hogy már az eddigi vízszintemelés is (amely csak a Tisza medrének teljes feltöltését jelenti) növelte az Oligochaetae-k egyedszámát a bentoszban, ami a halak táplálkozása szempontjából előnyös változás.

A halállomány fejlődés-dinamikája a fauna elszegényedés irányába mutat. A Carassius auratus gibelio robbanásszerűen elszaporodott.

A körzet hullámterében kialakult gémtelep (valószínűleg a legnagyobb Tisza-menti gém-kolonia) felmérése megtörtént.

A Sarudon és Tiszaszöllősön működő mezoklíma-mérőállomásaink folyamatosan szolgáltatták adataikat.

A kiskörei Tisza II. Laboratóriumban dolgozó munkatársak mint Munkacsoportunk egyik egysége működtek.

2. Körtvélyes-sziget (Mártély-Sasér Tájvédelmi Körzet) térségében.

A Körtvélyesi-holtág bakteriológiai vizsgálata a víztömegbe kerülő szennyvíz, algológiai kutatása peszticidek mérgező hatását mutatta ki. A zooplankton vizsgálatok megállapították, hogy a nyári hónapokban fokozatosan romlik a víz minősége, a béta-alfamezoszaprob szervezetek száma jelentősen nő. A vízszennyezés károsító hatása a növény- és állatvilágban egyaránt mutatkozott. A Munkacsoport javaslatára, az Országos Vízügyi Hivatal támogatásával, az Alsó-Tiszavidéki Vízügyi Igazgatóság elkészítette egy csatorna tervét, amely a holtágat a szennyvíztől mentesíti majd.

A hullámtér mocsárrétjén, az állományszerkezet és szervesanyag produkció kapcsolatok terén, végzett vizsgálatok kimutatták: A hosszantartó vízborítások után, a réttársulások közül a Tiphoides arundinacea állományok regenerálódása a leglassúbb. Közel azonos zártságú és magasságú asszociációk esetén a földfeletti szárazanyag produkció annál nagyobb minnél homogénebb az állomány.

Megállapítást nyert, hogy a Körtvélyesi-holtágban nagy mértékben elszaporodott növényevő halak (Ctenopharyngodon idella és Hypophthalamichthys molitrix) kipusztították a vízi és parti növényzetet, veszélyeztetik az őshonos halállomány fennmaradását. Munkacsoportunk javaslatot terjesztett elő az illetékes szervekhez, amelyben felhívta a figyelmet a halfajok kártételére.

A nemesnyárasokban elhelyezett madárodú telepeken madár-bromatológiai vizsgálatok folytak, azzal a céllal, hogy tisztázzák az odúlakó madarak szerepét az erdő megbomlott biológiai egyensúlyának helyreállításában.

Körtvélyes-szigeten működött I. sz. Bázis, mint anyagmegőrző és szálláshely. A körzetben telepített mezoklíma-mérőállomás és rovarfogó fénycsapda rendszeresen szolgáltatta a klimatológiai és entomológiai adatokat.

3. A tervezett Tisza III. (csongrádi) Vízlépcső és Víztároló térségében.

A Kiskunsági Nemzeti Parkhoz tartozó Lakiteleki-holtág és a mellette húzódó Tős-erdő még eléggé természetes állapotban maradt fenn, így a Tisza szabályozása előtti viszonyok rekonstruálására alkalmas. A Tiszakutató Munkacsoport vizsgálatai — a jelenlegi állapot rögzítése mellett — a tájrekonstrukciót készítik elő.

Megtörtént a terület általános földrajzi feltérképezése.

A Lakiteleki-holtág vízkémiai vizsgálata kimutatta, hogy a déli szakasz — Tős-erdő-Fürdő szociális szennyvize hatására—kissé szennyezett, északi szakasza tiszta.

A botanikai feltérképezés három erdőtársulásra terjedt ki.

A madárállomány ökológiai viszonyainak feltárása kimutatta, hogy a vízszint-ingadozás a terricol fészkelő fajokra szelektív hatást gyakorol.

A Tős-erdőben felállított II. sz. Bázis az év folyamán jól működött.

4. Egyéb Tisza szakaszok.

A Tisza egész hazai szakaszán — az Országos Vízügyi Hivatal és a Közép-Tiszavidéki Vízügyi Igazgatóság támogatásával—végzett, két hét időtartamú hossz-szelvény vizsgálat jelentős adatokat szolgáltatott a Tiszán lehaladó víztestekre vonatkozó ismeretekhez. A Tisza jugoszláviai zsakaszán végzett tanulmányút pedig előkészítette a jövő évi — várhatóan a folyó torkolatáig terjedő — hossz-szelvény vizsgálatot.

Befejeződött a Tisza egész magyarországi szakaszáról készített Syrphida-gyűjtemény feldolgozása.

Sikerült tisztázni a tisza-völgyi erdők puhatestűekkel való benépesülési folyamatának kérdését.

Az Alsó-Tisza Riparia-koloniáin végzett felmérés megállapította, hogy az állomány — több éves visszaesés után — némileg újra növekszik.

Az etológiai vizsgálatok terén megkezdődött a vízimadarak vészhangjainak szonogram-rendszerű analízise.

Fentieken kívül kutatott terület volt még: a Maros, a Sajó és a Keleti-Főcsatorna.

1977-ben a Tiszakutató Munkacsoportban 48 kutató dolgozott. (Ebből 20 hidrobiológiával, 5 botanikával, 21 zoológiával, 2 természeti-földrajzzal foglalkozott).

Megjelent a Tiscia XII. kötete, amelyben 18 tanulmányban ismertették a munkatársak vizsgálataik eredményeit.

További 11 dolgozat egyetemi, múzeumi évkönyvekben látott napvilágot.

Az április 22—23-án tartott VIII. Tiszakutató Ankéton 22 előadásban számoltak be a Csoport tagjai előző évi kutatásuk eredményéről, amelyeket mintegy 60 hozzászólással vitattak meg a résztvevők.

Az Ankéton kialakult határozatokat, ajánlásokat megküldték az illetékes intézményeknek. Az előadások kivonatát publikálták.

További 13 előadást tartottak a munkatársak különböző hazai tudományos és gyakorlati irányú szakmai rendezvényeken. Két előadás külföldön hangzott el.

Az év folyamán egy munkatárs kandidátusi fokozatot szerzett Tiszakutató témából. Ketten benyújtották kandidátusi disszertációjukat. Hárman készítenek egyetemi doktori disszertációt.

A könyvtár, amely elsősorban a Tisciáért cserében kapott több száz, értékes hazai és külföldi — a vizek és környékük kutatásával foglalkozó — kiadványt tartalmaz jelentősen tovább fejlődött.

A csak vízi úton megközelíthető hullámtéri területeken a „Kolokán” kishajó eredményesen szolgálta a kutatást.

A kutatómunkáról részletes tájékoztatás készült az MTA Hidrobiológiai Bizottsága, természetvédelmi tevékenységünkről pedig az MTA Botanikai Bizottsága részére.

A Tiszakutató Bizottság:

Dr. Horváth Imre (elnök), Dr. Bodrogközy György, Dr. Móczár László (elnökhelyettesek), Dr. Marián Miklós (titkár), Dr. Andó Mihály, Dr. Ferencz Magdolna, Dr. Gallé László (sen.), Dr. Kiss István.

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FROM THE LIFE OF THE TISZA-RESEARCH WORKING COMMITTEE TISZA-RESEARCH CONFERENCE VIII

Compiled by

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The Tisza Conference, arranged annually by the Tisza-Research Working Committee, took place this year on 22 and 23 April. In the course of this, there were delivered twenty-two lectures and brief accounts, respectively, followed by questions, contributions, addenda, resp. lecturers' replies.

The Conference began with the inaugural address of Dr. IMRE HORVÁTH, Professor and Head of the Department of Botany. He greeted Dr. PÁL GULYÁS, appearing on behalf of the Scientific Research Institute of water Management, Academian Dr. AMBRUS ÁBRAHÁM, and Head Physician Dr. PIROSKA KISS. He surveyed the subject-matter of the accounts to be lectured, arranged around two research projects: (1) investigations performed in the district of the Tisza river barrage and the nature conservation areas, (2) those in other Tisza reaches.

Lectures of domain I

(1) HAMAR, J.:

On the natural purification of the Tisza

Conceptual sphere of the natural purification. Biotic, abiotic factors, taking part in the purification of the river, carrying it out, resp. influencing it. On the role of the water course and suspended matter content of the river. Analysation of the oxygen household. Biomass and production of the bacterioplankton, its importance in the natural purification. Dynamism of the eutrophication processes.

On the characteristic purification mechanism of the Tisza. Changes to be expected in the capacity of natural purification of the river.

Contributions to the discussion:

HORVÁTH, I.: It turned out of the lecture that there are many bacteria to be demonstrated in the water of the river. It is, however, questionable whether we can talk of the active production of bacteria. — Answer: Yes, there was measured a production like this and proved with investigations that these bacterial masses were active.

SZITÓ, A.: The co-operation of what factors is the smaller floating-matter content in Autumn attributed to by the lecturer? — Answer: The floating-matter content, released by snow and ice in the winter period, is drifted by the water mass of the spring flood. This surpasses in quantity the amount demonstrable in the autumnal period.

GÁL, D.: According to his establishment, in the Tisza stretch below and above Szolnok, i the field of O_2-consumption, there can be observed no considerable difference. It is, however, questionable if there is any difference in the appearance of the phyto- and zooplankton stocks. — Answer: Yes, there can be demonstrated a considerable difference from biological point of view.

GULYÁS, P.: What is the quality of Tisza water on the basis of evaluating the results of investigations into the longitudinal section? — Answer: On the basis of the classical parameters (primarily from chemical point of view) it is to be considered as pure. At the same time, on the basis of N and P quantities, some difference can already be demonstrated. The absolute quantity of Na milligramme is also showing a rising tendency.

(2) VÉGVÁRI, P.:

Problems of regulating water quality at the Kisköre Reservoir

Before filling up the Kisköre Reservoir, he is analysing the possibilities by means of which the chemical composition of the water masses stored becomes regulable and the formation of a healthy water system and the most favourable state for promoting its optimum utilization can be promoted.

He is investigating into the solutions on the basis of which the formation of the deposits in the reservoir can be influenced. He renders account of the elaboration of the correlations between salt and water outputs with the help of which we can get continuous informations on the salt circulation of the water supplying the resenvoir.

Contributions to the discussion:

ANDÓ, M.: It is well-known that at low water the salt concentration of water is high, at high water on the other hand, the floating matter content is high. The question is, of what kind of water it is planned to fill up the reservoir. — Answer: The descending branch of floods is the most suitable for filling the reservoir.

(3) BANCSI, I.:

Results of investigations carried out with Reglone and Gramoxone herbicides in the Kisköre Reservoir

Before using herbicides to protect water quality, we had to evaluate the results of a wide range of experimental data. The literary data have given sufficient information in several connections. The missing ones were substituted for under laboratory and field conditions in 1976, resp. the existing data were checked up.

The results of the toxicological investigations can be considered as favourable. — The effect of chemicals was analysed under field conditions in small basins (25×25 m); in respect of bacterio-, phyto-, and zooplankton. The incorporation of chemicals in fishes and the possible morphological changes were followed with attention. — Our investigations included ascertaining the phytotoxic effect of "Regolone" and "Gramoxone", the decomposition and accumulation of chemicals.

The results of investigations are favourable for the majority of cases (plants, soil, water, sediment, water organisms). In the lecture his results are exposed.

Contributions to the discussion:

KERESZTES, T.: Whether in the water-plant stock the lecturer measured any herbicide concentration. — Answer: He did not.

GULYÁS, P.: How do they plan to remove the remains after burning the wood stock in the stocking area? — Answer: They try to burn it fully. He remarks that the woods are largely not under the management of the Water Administration, he cannot give, therefore, any definite answer in this relation.

(4) Mrs. LÁSZLÓ DOBLER and MÁRIA HEGEDŰS:

Data on the water quality of the Tisza dead-arms in the region conservation district at Mártély—Sasér

The research work in the dead-arm at Körtvélyes and Atka began in 1976. Water samples were generally taken with monthly frequency.

The analysis of water areas was justified primarily as a continuation of investigations having begun in this district (Mártély dead-arm) in 1975 and, on the other hand, in the interest of a complex research. The water as living-space is namely inseparable from the terrestrial ecosystem, the knowledge of that is, therefore, indispensable.

The dead-arms were investigated into in a complex way, applying bacteriological and hydrobiological methods.

On the basis of the results obtained, we could conclude the external effects reaching the water spaces in question. At the same time, we could follow with attention the seasonal change of the aquatic ecosystems, as well. By means of the bacteriological investigations, we could register the degree of pollution, resp. the change in it.

As the water claims increase, apart from the lack of water, water quality will be the minimum factor. In this relation, the water quality of dead-arms has, therefore, a great importance.

Contributions to the discussion:

MARIÁN, M.: Does the water taken out of the dead-arms for irrigation get later back again into the dead arm? From where do coliform bacteria gain access to the water in such a large mass? — Answer: A part of the water taken out gets back. The coliform bacteria don't get into the dead-arms but they proliferate there if having adequate food. At any rate, they can also get into casually, together with refuse water.

HAMAR, J.: Could there be observed the occurrence of a major Cryptomonas invasion in the waters investigated? — Answer: There was observed none.

(5) KISS, I.:

Algological investigation of the Tisza dead-arm at Lakitelek Tőserdő

The northern larger part of the dead-arm, together with the recreation area, has belonged to the Kiskunság National Park since 1976. The southern smaller part is an unprotected area, playing a part of the planned Alpár Reservoir. By these conditions, the algological investigation into the two parts of the dead-arm is sufficiently justified.

Water samples were taken, in the preceding years, but in the district of the recreation area at Tőserdő. From 1976 on, we have been sampling from the southern stretch, as well, at least in every season. The protected part at Tőserdő, resp. the district of the recreation area, has proved to be so far the richest in algae.

I have till now observed more than one species in the alga flora that may be considered as a rarity. There are like this, e. g., *Desmatractum indutum, Desmatractum bipyramidatum, Dictyosphaerum pulchellum, Centritractus africanus,* and *C. belenophorus, Fusola* spec. These occur but rather sporadically. *Ceratium hirundinella* has appeared in large numbers, mostly in every water sample, with a considerably variety of forms. Those belonging to the genus *Scenedesmus* have presented themselves in a large variety of forms, as well. *Microcystis aeruginosa* has also appeared here and there, in large numbers, mostly in the neighbourhood of the bridge — what is indicative of the eutrophication of water. There have so far been found all in all nearly 100 algal taxons.

This mass-production colouring which stained the water surface, resp. the upper 0.5 cm layer of that, brownish-green in the part et Tőserdő, particularly in the area of the landing-stage, on 29 September, 1976, is worth mentioning from the point of view of vegetation. In this, *Ceratium hirundinella* also occurred in mass. On 23 September, the water was poor in phytoplankton, as yet. In this change, weather may have had a considerable part, as well.

Contributions to the discussion:

HAMAR, J.: Ceratium hirundinella was also found in more than one dead-arm along the Tisza Occurring in moving waters in a very wide range of qualities, it cannot be considered unequivocally as an indicator of quality.

GÁL, D.: He similarly confirmed that this species was to be found, also in large numbers, in the dead-arms at Körtvélyes and Alpár.

(6) HEGEDŰS, MÁRIA and Mrs. LÁSZLÓ DOBLER: Microbiological investigations into the Tisza reaches in County Csongrád, in 1975 and 1976

A satisfying answer to the problems raised by water utilization and environmental protection, as well as by the protection of water quality can only be given on the basis of the results of complex water examinations. We have, therefore, conducted a survey, comprizing both the bacteriological and biological parameters.

In the years 1975 and 1976, in the Tisza reaches in County Csongrád, we took, together with the laboratory of the Water Management of the Lower Tisza Region, 196 water samples, and elaborated these. Parallel with this work, we have also analysed the water of two considerable tributaries, the Hármas- (Triple) Kőrös and the Maros, on the basis of water samples taken from above the river mouths.

The applied bacteriological and biological methods enabled us to follow with attention the changes taking place in water quality.

Contributions to the discussion:

GÁL, D.: What kind of limiting values are meant by the waters belonging to category four? — Answer: This is a hygienic water qualification, performed in the National Water Office, on the basis of a sectoral standard project.

HAMAR, J.: Has the total germ count got a valuable dynamism? — Answer: Yes, for instance, the germ count cultivated at 20 °C is generally higher then that cultivated at 37 °C.

Could the total germ count be established in the swelling at Óbecse and was a change in the algal composition? — Answer: In relation of the germ count, the number of those, bred at 37 °C has increased. There was some change in the algal associaiton to be observed, as well, because the Chlorococcales species also appear in large numbers.

What kind of larger changes were caused by the coliform bacterium in the water-body? — Answer: It promotes, on the first hand, purification and, on the second hand, it has the indicating part at the installations of refuse water.

KISS, I.: At evaluating averages, was the algal number evaluated by the lecturer? — Answer: The algal number was not evaluated.

KISS, PIROSKA: Calls the attention to that, at investigating into subject-matters like this, an answer must always be looked for to problems of hygiene.

(7) GÁL, D.:

Some characteristics of the zooplankton of the Tisza dead-arm at Körtvélyes

In the period between 1971 and 1976, on the basis of investigations performed by the month, the most important characteristics of the quantitative and qualitative changes in the zooplankton of the Tisza dead-arm at Körtvélyes are as follows.

In the zooplankton, there are mostly the Rotatoria species which dominate both in species and individual numbers.

The change in the total individual number of zooplankton generally shows two maxima annually: a larger one in Spring (generally in May) and a smaller one in Autumn (mostly in September—October).

The change in the total individual number is highly influenced by the seasonal formation of temperature. On the basis of data obtained so far, for the zooplankton association developed in the Tisza dead-arm at Körtvélyes, the water temperature between 15—25 °C is the optimum. In case of a water temperature higher or lower than this the total individual number of the zooplankton considerably decreases.

The quantitative and qualitative composition of the zooplankton is considerably modified by the floods inundating the dead-arm. At high water, the amount of zooplankton strongly decreases. But after the flood had passed, the original balance returns to normal in a short time.

In the course of the year, the saprobiologic quality of the water in the dead-arm considerably changes. In the winter months, until about May, the oligobeta- and beta-mesosprobic organisms predominate (o.-b.: 43 per cent, b. 38.9 p. c.). the beta-alpha mesosprobic species are present but in a low percentage (13.9 p. c). In the summer months, the water quality more and more deteriorates, the number of beta-alpha-mesosaprobic organisms and their individual number increases (37.8 p. c.), and at the same time, the percentage of the oligo-beta- and beta-mesosaprobic organisms considerably decreases 32.7 p. c.).

Contributions to the discussion:

GULYÁS, P.: He asked what species in the zooplankton pullulated in August and meant a – b mesosaprobity. — Answer: In this period the number of species is about two hundred. He can reply to the question only after studying the list of species.

MAGYAR, L.: Has the lecturer observed any difference between the material of the samples collected from both ends, resp. the middle of the dead-arm? — Answer: There are differences to be observed but these are not characteristic.

HAMAR, J.: It is to be taken into consideration that, on the occasion of floods, the zooplankton drifts from the dead-arm into the Tisza.

(8) SZITÓ, A.:

Bentnos investigations into the Tisza stretch between Tiszafüred and Kisköre

He has continued the investigations begun in 1971 in the dead-arm at Tiszaüfred and in the Tisza stretch between Tiszafüred and Kisköre. Sampling sites were: the dead-arm close to the sands and, in the Tisza, above Tiszafüred—Örvény (428 river km) and Kisköre (406 river km).

Date of sampling: 27 May, 16 September, 28 October. In the period before May, sampling was impeded by high water. Due to the flood, the parts of river-bed, watter-covered in the Autumn, could not be found. On the right, as well as left banks of the dead-arm and the Tisza, ten-ten samples were taken, on every occasion, on the side of the river, in different distances from the riverside covered with water. From these, the Chironomida species were determined.

On the basis of investigations it was established that in the samples taken from the depths of 0.5 to to 6.0 m there could be observed no close connection between the individual number of animals and water depth. The individual number of Oligochaetae increased, as compared with that in the earlier years. From among the Chirinomidae the dominant species are: *Chirinomus plumosus, Ch. fluvietalis, Tanypus punctipennis.*

In October, the body of Oligochaetae was full of cocoons, and a large number of these was also found in the samples, as well.

(9) BODROGKÖZY, GY. and HORVÁTH, I.:

Connection between stock structure and organic matter production in the marshlands of the flood-plain at Körtvélyes

By availing themselves of three plant associations in the flood-plain of the Tisza at Körtvélyes, they have dealt with the question, what kind of connection is in case of these considerably homogeneous associations between stock structure and organic matter production. There were performed coenological investigations in all the three plant associations in the course of the growing season, determining the weight of the underground and surface phytomasses.

From among the three stocks, in respect of the species composition, *Baldingeretum arundinaceae* was the most homogeneous.

The most organic matter was given by *Baldingeretum arundinaceae* and the least by *Caricetum gracilis nutantis alopecuretosum.* The phytomass below surface is very high at all the three coennoses.

The close linear connection between the surface phytomass stock structure is proved by that the higher participation-proportion of dominant species — that is to say, the more homogeneous plant stock — produces a larger dry-matter quantity in case of a nearly identical closeness and plant-height. It is likely that this is connected with the alolopathic effects, too.

Contributions to the discussion:

MARIÁN, M.: The investigation into the plant stocks and their productivity is important in zoologica relation, as well. These are namely — according to the investigations, so far — in a close connection with the insect fauna. — Answer: Habitats should always be examined in a complex from, following the formation of food-chain to the very end.

BELICZAY, I.: How much is the level difference between the single investigated meadow-caenoses? — Answer: The existing level-difference were determined by estimation. There were given differences of about 10—30 cm.

How strong is the accomodation of the species Typhoides arundinacea and *Alopecurus pratensis* to the flood? — Answer: The adaptability of the latter one is better than expected: it tolerates even 2 to 3 m high flood for a longer time than the first one. *Typhoides* can only regenerate injury after high water in a longer time.

VÉGVÁRI, P.: Can alkalization be demonstrated in the marshlands of the flood-plain and what is its degree? — Answer: At present, the initial stage of alkalization can be demonstrated from the soil of these marsh-plains. This, however, has no influence, as yet, on the plant species tc be found.

(10) MARGÓCZI, KATALIN:

Botanical investigations in the Tőserdő

Tőserdő, lying beside the dead-arm at Lalitelek, is an interesting area in botanical relation, as well. Its most known part is the alder plantation which has already for a long time been a conservation area.

In the course of the foundation of Kiskunság National Park, in 1975, the about 5 km long dead-arm and the gallery forest encircling that became protected in their entirety, constituting a part of the National Park.

The full botanical exploration of this Tisza stretch is an important task so much the more, because this area is undisturbed and therefore suitable to be reconstructed. The initiated investigations would like to promote primarily this region-reconstruction.

In the foregoing, the botanical mapping of three different forest associations took place. The investigations into stock, climate, and production enable us to designate the areas which are the most suitable for the plantation of different forest types.

Contributions to the discussion:

HAMAR, J.: How has the degree of frequentation an effect on the plant stocks discussed? — Answer: An effect like this cannot be observed, the frequentation being but of small degree.
What could be established concerning the spreading of *Amorpha* abd *Vitis* — Answer: *Amorpha fruticosa* spreads in the investigated area at the fringes of forests the most intensively. *Vitis riparia*. as a vine species grown wild, is already a characteristic lianeous plant of the forests along the Tisza.

BODROGKÖZY, GY.: He recommends the lecturer to lean on wider references in ocnnection with his subject-matter. He is missing the elaboration of a literary material of knowledge.

(11) FARKAS, Á.:

Experiences of the fish destruction at Körtvélyes; the appearance of the herbivorous fishes and the ecological relations of their role

In the last week of May, 1976, he observed a considerable fish perdition in the Tisza dead-arm at Körtvélyes. This may have been caused by a pesticide getting in from the adjacent rice-fields or possibly the *Salmonella* infection demonstrated from the water with a bacteriological test. Since the date mentioned, ha has not observed any fish perdition in the dead-arm.

He is presenting the colour slides taken of the fish carcasses washed to the riverside.

He saw first *Ctenopharingodon idella* individuals of 200—250 g weight and *Hypothalmichthys molitrix* individuals of 350—400 g weight in the Tisza dead-arm at Körtvélyes in the Summer of 1974. While the occurrence of both fish species, caught in 1974 was accidental, in 1976 they already belonged to the main profit-fishes of fishers.

According to his supposition on the basis of his experience, which is supported by the opinion of fishers, as well, these species spawn in the dead-arms.

The disappearance of the worms, insects, living on the water-plant coenoses exterminated by *Ctenopharingodon idella* from the dead-arm results in the interruption of the food-chain, leading thus possibly to the depopulation of our autochthonous fish stock.

Contributions to the discussion:

SZITÓ, A.: He is calling the attention to that instead of the designation "herbivorous fishes" it would be more precise to use the expression "far-eastern fish species". He does not agree with that these fish species cannot be regulated in the Tisza dead-arms. By being caught, they can be extirpated from the endangered waters. — Answer: This is true only theoretically, practically their radical extirpation is impossible.

MARIÁN, M.: In the protected Tisza dead-arm at Körtvélyes, as a result of the rapid breeding of the far-eastern fish species, the aquatic vegetation has entirely perished.

HAMAR, J.: Why is the water in the nature conservation areas, resp. region conservation districts not protected? — The answer was given by Mrs. Balázsfalvi Attila, the representative of the National Nature Conervation Office: It is impossible to protect the Tisza in its whole length. And the problem of the dead-arms is insoluble owing to their role as inland reservoirs.

MAGYAR, L.: It is possible that fishes gollop the grains of poplars of the gallery forests around the dead-arms falling into the water, what may contribute to their perdition. — Answer: It is possible that the poplar grains supplied with a parachute outfit contribute to the periodical fish perditions.

GULYÁS, P.: The Scientific Research Institute of Water Management does not propose to introduce fish species like these into the dead-arms.

(12) MARIÁN, M.:

Some ecological characteristics of the bird stock of the Tőserdő

An eight-member research team, formed of the Tisza-Research Working Committee for this purpose, in 1976 began a systematic ornithological fact-finding investigation, planned for two years, in the Tőserdő lying in the flood-plain of the Tisza and belonging to the Kiskunság National Park. The members of the team are: ATTILA BANKOVICH, ISTVÁN BOGDÁN, ISTVÁN LŐRINCZ, Dr. LEVENTE MAGYAR, GYULA MOLNÁR, LAJOS PUSKÁS, LÁSZLÓ SALAMON, and the lecturer.

While in 1976 the aim was to collect and evaluate the faunal, ecological and phenological data — and the lecture renders an account of the ecological factors considered to be the most important ones from among these — in 1977, however the programme is the quantitative survey of the bird stock.

49 from the 81 bird species observed in the investigated area hatched in this area. The lecture is analysing the effect of the environmental factors regulating the vital conditions of nesting species. It takes into account in any case also the anthropogenous effects.

From among the aquatic ecosystems, the small forest bog has the least attraction and feeding capacity (its characteristic species is *Gallinula choropus*). The so-called age-worn ox-bow lake of the Dead Tisza has a more important role. It is characterized by: *Ixobrichus minutus, Acrocephalus arundinaceus,* and *Acrocephalus schoenobaenus*. To the living-space of large extension of the Tisza dead-arm at Lakitelek, and to its organic-matter base, a large number of aquatic birds are bound. (It is characterized by: *Anas platyrhynchos, Aythya nyroca, Fulica atra*).

Investigating into the living possibilities of the species living in the terrestrial ecosystem according to the forest levels, he established that the life of terricolous species is influenced by floods.

The nest-placing of 26 bird species was investigated on 14 different plant species (together in 83 cases). In respect of nest-placing, there could not be ascertained any specialization in plant species or plant associations.

Contributions to the discussion:

MAGYAR, L.: Is there a regular system in the localization of nesting-box investigated, e. g. placing them according to the quarter of the heavens? — Answer: A system like this has not been applied.

ÁBRAHÁM, A.: Why is the investigated forest section called "Tőserdő"? — Answer: It is a contracted popular designation instead of oak-forest (Tölgyeserdő).

II Investigations performed in other Tisza stretches

(13) STAMMER, ARANKA, HORVÁTH, I., CSOKNYA, MÁRIA, and HALASY, KATALIN: Structural investigation into the oblong medulla of Tisza fishes

The structure of medulla oblongata, being at a lower level of development as compared with that of the higher vertebrata, differs between silver carp *(Carassius auratus gibelio* BLOCH) and pike *(Esox lucius* L.*)*. In the fish of prey, the projection tracts, the formatio reticularis, and the spinobulbar nuclei are stronger developed. The nuclei of the spinobulbar nerves, mainly the groupings of the sensory ganglia are different. The nuclear group eliciting the respiratory and circulatory rhythms of fishes is not circumscribed.

An environment poor in oxygen, elicited artificielly, induced a much stronger change in the mitochondrial and membrane structure of the nerve cells of the pike than in the silver carp.

(14) CSOKNYA, MÁRIA, HORVÁTH, I., STAMMER, ARANKA, and HALASI, KATALIN: Mitochondria in transformation,being in the thoracal ganglion cells of the may-flower larva

The most important characteristic of the abdominal ganglionic nervous system of the may-fly larvae is the fusion of ganglia. In the structure of thoracic ganglia, the nerve cells are of peripheric, while in the fibre substance of central localization. The sizes and plasmatic organella of the nerve cells show various differences.

Their most characteristic cell-organelles are the mitochondria, a part of them is — apart from the structural changes — also transformed. The transformation takes place with the interpolation of the so-called paracrystelline bodies.

The authors think possible that the altering mitochondria have a part in the material and energy flow of nerve cells as reserve (depot) materials.

Contributions to the discussion:

ÁBRAHÁM, A.: The injuries in the nervous system can be followed less than in the branchia. It is probable, at any rate, that the moment when the injury took place, could not be registered.
WOLEMANN, MÁRIA: The biochemical (enzymological) change precedes the morphological one.

(15) VÁNCSA, A. L.: The tychoplanktonic algal associations of the Sajó

The qualitative and quantitative composition of the tychoplanktonic algal vegetation of the Sajó, on the basis of the 885 water samples investigated between 1965 and 1976, may be characterized with the rule of diatoms (Bacillariophyceae). The algal associations of heterogeneous composition (of rheon-, rheoplankton- and plankton-charakter) feel well the water-using, water-polluting activities of the man, as well as casually the influence of the more important tributaries in the Sajó. The peculiar forms of the algal population maxima are the following: these coming from beyond the frontiers, from the tributaries, being formed primarily or secondarily in the Sajó. Their recognition makes more effective the characterization of the state of water quality and the estimation of the possibilities of the use of water, aiding in this way the practical water-qualifying activity.

In the Sajó, apart from the tychoplanktonic algal associations of average composition and medium population, we can distinguish algal associations of various composition and rich population, of various composition and thin population, of poor composition and rich population, of poor composition and thin populaltion which characterize particular conditions.

For presenting the tychoplanktonic algal associations of the Sajó, the results of seven characteristic longitudinal-section investigations are used.

Contributions to the discussion:

MARIÁN, M.: Will take place any riverbed regulation in the Sajó? With what kind of materials is it polluted? — Answer: He does not know about any plan of rivercontrol. The pollution of the Sajó water is mainly induced by the Integrated Chemical Works of Borsod and the Lenin Metallurgy Works with introducing materials of sulphuric content, although the pollutions coming from agricultural areas are also considerable.

(16) VÁNCSA, A. L.:

Results of the algological investigations performed in the bed-section of the Sajó below Miskolc

The Sajó reaches the district of Miskolc with a considerable amount of pollution and the quality of its water is here fundamentally changed by the activity of man using and polluting it. The river stretch below Miskolc, apart from the basic load, is only loaded by the sewage-water of some minor settlements, resp. by the pollutions coming from agricultural water usages and run-offs from land. The double mouth of the Hernád occasionally considerably deteriorates the conditions of pollution and self-purification but it may have a favourable effect, as well.

It follows from this that, in the river stretch between the mouths of the Szinva and the Hernád, there may develop favourable conditions from the point of view of self-purification and some realization of these processes can be observed, free from any disturbing effects.

The double mouth of the Hernad, apart from the existing similarities, can be characterized with considerable qualitative and quantitative differences.

Corresponding to the experiences of the earlier years (1965 to 1975), also definitely presents itself in 1976 the effect of the double mouth of the Hernád in the Sajó — in the short river stretch before discharging into the Tisza — and that is illustrated well by the comparison of the characteristic results of the longitudinal-section investigation on 19 and 20 July, 1976.

The results are useful for the water-quality investigation of the Tisza.

Contributions to the discussion:

HORVÁTH, I.: What is the effect of the polluting materials on the algal organisms? — Answer The effect of the polluting materials manifests itself mainly in the quantitative indices of algae.

Of what degree and how extended is the polluting effect of the Sajó on the Tisza? — Answer: The polluting effect of the Sajó water on the Tisza can be observed well but he has not investigated, as yet, the range of pollution there.

Is there a possibility to reduce the polluting materials considerably? — Answer: The possibilities of this do exist.

KISS, K. T.: Why did the lecturer call the algal associations living in the Sajó tychoplanktonic algal organisms? — Answer: He made the tychoplankton denomination appear as a collective term.

HAMAR, J.: Are there heterotrophic algae? — Answer: The lecturer has not given any positive answer.

(17) TANÁCS L.:

Contributions to the dominance and abundance relations of the Apoideae living in the flood-plain and on the dams of the Tisza

He performed abundance and dominance investigations in 1975, for 26 days, on the dam and flood-plain along the reaches between Tiszasziget and Tiszacsege. In the collection carried out for ascertaining the structural composition of the flower-frequenting hymenopteric insect population, the individual number of Hymenoptera was above 1100, that of the determined wild bees 993.

The most important flower-frequenter proved to be *Halictus eurygnatus* (18.83 per cent). The dominance of *Lasioglossum malachurum* (6.45 p. c.), the *Lythrum*-visiting *Melitta nigricans* (9.56 p. c.), *Tetralonia salicariae* (5.34 p. c.), *Tetralonia ruficornis* (4.23 p. c.) can be regarded as considerable. The dominance of more than one swarm of wild bees is remarkable like that of the *Andrena flavipes, Lasioglossum morbillosum, Tetralonia, Eucera,* and *Bombus* species which can be found in most habitats.

The density of the wild bee population increased more and more in the course of Spring. The abundance of the flower-frequenting Apoidea-group revealed the greatest value in midsummer on the basis of measuring (680 widl bee ind./ha). The Apoidea stock density was considerably influenced by mowing. Abundance rapidly decreased in the course of September.

The abundance value of the domestic honeybee changed during the observations between lo and 970 individuals/ha.

The wild bee population showed a changing composition, taken as a function of the flowering aspects, during the flying time. In Spring, the first generation of *Andrena* and *Halictus* genera, as well as the *Bombus* species; in the course of May and June *Eucera*, later on the *Megachile* species were considerable stock-makers. In midsummer, the second generation of the species of the *Halictus* and *Andrena* genera, as well as the individuals of *Melitta nigricans, Tetralonia ruficornis,* and *Tetralonia salicariae,* visiting the *Mythrum* species, appeared as the most important representatives of the population. These species not only represented a considerable proportion of the wild bee population but also considerably increased abundance.

As evaluated according to flight-time, the species of two generations with a long swarming and the semisocial species are the most considerable.

Contributions to the discussion:

GALLÉ, L.: Did the lecturer find hylophilous Apoidea species in the course of his investigations? — Answer: He did.

HEGEDŰS, MÁRIA: Are mosquitocides used on dams and in flood-plains? — Answer: According to the information obtained from the Water Managements of the different Tisza Regions, there are used no insecticides like this at all; the areas have only got fertilizer treatment.

BELICZAY, I.: Was there made any proposal to influence the phytocoenoses of the areas investigated by the lecturer for making them more favourable from apicultural point of view? — Answer: Taking into consideration the points of view of dam protection and mowing, there was presented a suggestion for controlling, transforming the phytocoenoses, developed here, reasonably in this direction. This could have satisfied, to a certain extent, also the demands of apiculturists. The presented proposal was, however, not realized. (The proposals promising to be useful in apicultural respect are contained in the conclusion of the Conference).

(18) BÁBA, K.:

The water-carried mollusks of our rivers and the analysis of the fauna of the deposit

Since the publication by CZÓGLER and ROTARIDES in 1938 on the fauna of the deposit of the Tisza in the environment of Szeged, the problem of analysing the deposit was not dealt with by malacologues. The investigation into the drifted fauna became timely again when the part of snails carried by the river water in the primary stocking of the flood-plain and in the further succession of snail associations after stocking arose.

The author has carried out the analysis of together 19 deposit samples coming from the Tisza, the Danube the Maros, the brook Szalajka, and five from the upper Pleistocene, concerning land snails, on the basis of approximately 30,000 indibiduals.

He has analysed the samples collected with casual sampling by investigating into the interval of the frequency proportion confidence. From the deposit samples there were found 99 species.

It is to be established on the basis of samples that the 27 common species of the 19 samples, in respect of their dominance and the range of their being carried, is different in the single rivers. The recent samples differ from those in the upper Pleistocene, even in respect of the sequence hierarchy of the carried snails. The single rivers have a certain "individuality" from the point of view of the qualitative composition of the carried material.

On the basis of the experiences, the composition of the drift fauna is determined by the climatic potentialities. The difference between the recent alluvial composition and that from the Pleistocene is also to be ascribed to the different climates.

Contribution to the discussion:

GALLÉ, L.: Is the survival of the snail population influenced by the competitive interactions between the populations? It would be very important, to continue analysing the drift fauna of the Maros — Answer: An influence like this could not be demonstrated in the course of investigations.

MARIÁN, M.: What species are classified by the lecturer into the drift species? — Answer: Drift species are generally called those drifted from the mountainous districts or from other farther regions of the Plain.

MAGYAR, L.: How broad is the stripe of current? — Answer: It is changing but this is only limited to the low mountainous zone.

(19) ANTAL, Z.:

Hydrobiological investigation into the after-purifying systems. I Chemical investigations

The waste-water of the active-silt equipment of the Tisza Integrated Chemical Works, purifying the process-waters of the new olefinic and paint works is conducted down into a lake system consisting of six lakes. In the lakes, the daily 4000 to 4500 cubic metre purified waste water undergoes a fifty-day long biological after-purification and passes after this into the Tisza.

From the point of view of estimating the after-purifying effect, we considered the following components as essential: pH, dissolved O_2, BOI_5, KOI_{Cr}, Ca^{2+}, $Mg^{2+}K^+$, $So^{-2}/_4$, HCO_3^-, P and N-forms.

The solute O_2 content, oxygen saturation of the waste-water inflow alternated between 5—6 mg/l (45 to 50 per cent). And the oxygen saturation of the lakes was formed between 50 to 100 per cent mean values, meaning a considerable decrease as compared with that of the last year.

From the potassium-dichromate oxygen consumption we have concluded the quantity of the oxidizable organic matter. The KOI -value of the running waste-water rose from the average value 70 mg/l to 83 mg/l which corresponds to a rise of 15 per cent. On the other hand, the KOI_{Cr}-value of the running waste-water rose from the average value 70 mg/l to 83 mg/l which corresponds to a rise of 15 per cent. On the other hand, the KOI_{Cr}-value of the waste-water, lifted over to the Tisza and so flowing away, rose by 35 per cent as compared with that in the last year (on the average 62 mg/l).

The increased loading of lakes is shown by the results of measuring of conductivity, as well. A s compared with the last year, an increase of 70 to 100 per cent is to be observed. This is referred to by the measurement results of the total dry-matter content, too, showing similarely an increase of 70 to 100 per cent.

We consider as essential, to investigate into the M, P forms inducing eutrophication. As compared to the years gone, the binding of P in lakes has decreased. That nevertheless some favourable total P resp. orthophosphate left the lakes for the Tisza, that can be attributed to the decrease in the total phosphorus content of the waste-water inflow. The total phosphorus content of the purified waste-water, lifted over to the Tisza, changes between the values 0.1 and 0.3 mg/l, and the orthophosphate content between 0.05 and 0.15 mg/l.

The total mineral N average value of the waste-water inflow fluctuated between 2 and 4 mg/l. This decreased in the lakes to a much lesser extent than in the past year. The total mineral N content of the waste-water flowing away changed between the values 1.5 and 3 mg/l.

It is shown by the metric data that the lakes are overburdened and the water quality is deteriorated in its entirety.

(20) Kiss, K. T.:

Hydrobiological investigation into the after-purifying lake systems. II Algological investigations

In the after-purifying lakes, the binding of the decomposed polluting materials, vegetable nutritive materials, their extraction out of the water is "carried out" first of all by algae, hair-weeds, reed-grasses.

The algal population of the purified waste-water getting to the lakes was, taking into consideration both the species and the individual numbers, poor, without influencing the water quality considerably.

In February and March, 1976, following the thaw of ice, in the lakes, a plankton-algal stock of 20—30 million ind./l pullulated, dominated by *Cyclotella* and *Chryptomonas* species. The same was characteristic of the early Spring of 1977. In Summer, in the first two pairs of lakes the plankton-algal population was thin, in the last one, however, it was rich.

In 1975, in every lake, enormous *Cladophora* grases overgrew the bottom of lakes and later on also the water mass and surface. The heayv filamentous algal mass (in dry weight approximately 5 tons) considerably diminished the quantity of P and N salts in the water lifted over into the Tisza. Because of the omission of the optimum thinning, in Summer 1976, this filamentous algal mass perished. This was promoted by a fungal infection and by the overloading of lakes, as well. Thus the organic matter weighing a lot of quintals has induced a serious self-pollution and the till then favourable after-purifying effect of the lake system considerably deteriorated.

This effect must have been mitigated by that in the middle pair of lakes bulrush was introduced in the year before. The bulrush stock itself and the living coating, developing on the bulrush stalks exerted, by binding the material, a favourable purifying effect. As the bulrush stock is but 10 per cent of the surface of the full lake system, the purifying effect could not be of the same extent that could have been expected from the lake system.

We are convinced that, applied with a suitable technology, the lakes could exert the optimum purifying effect, sparing in this way the Tisza and the Kisköre Reservoir the considerable amount of "polluting material".

Contributions to the discussion:

HORVÁTH, I.: Is there any opportunity to employ profitably the organic matter *Cladophora* — Answer: It is probably possible to make use of it but there has not been carried out any investigation in this direction.

VÉGVÁRI, P.: How can reed be introduced into the lake systems? What is the solution of this problem?—Answer: This is a difficultly solvable problem. It is more successful to introduce, instead of this, bulrush and lake-clubrush.

HAMAR, J.: By which species was the algal maximum of the winter-period of 1976 brought about? — Answer: The lake systems in question enjoy a regular maintainance and, owing to this, *Clytocella, Cryptomonas,* and *Chlamydomonas* species bring about the algal maximum.

HEGEDŰS, MÁRIA: Are these lakes suitable at all for an after-purification? —Answer: According to the statements of the investigations, so far, they seem to be creased. In the time of winter samplings the amount of zooplankton markedly diminished, unambiguously determined by the oxygen-deficient environment, formed under the ice (strong bacterial activity, decrease in algal number, etc.).

We are reminded of by the harmfully changed chemical parameters, the increased algal number, together with the above described phenomena, that the oxygen-household, equilibrium of lakes were disturbed (it is to be feared that under the ice even anaerobes are to be taken into consideration), respectively that the large mass of algae and zooplankton (together with nutritive materials) getting into the reception basin (Tisza), promotes its eutrophication, endangers the water quality of the Kisköre Reservoir. And this is thoroughly undesired.

Contributions to the discussion:

BANCSI, I.: Is there a correlation between the amounts of algae and zooplankton? — Answer: Between the observed algae and zooplankton a remarkable correlation took place.

HAMAR, J.: In the course of investigating the water flowing away, could Ciliata be demonstrated? — Answer: Ciliata could be demonstrated from these waters only casually.

SZITÓ, A.: What was the temperature of water on the occasion of investigations? — Answer:

The temperature of water getting into the lakes changed between 12 and 25 °C but at the end of November the lakes froze in. Under the ice the temperature was −2 to −4 °C. In late February, the water temperature was 6—7 °C.

Could H_2S be demonstrated from the water? — Answer: Any release of this was not observed.

VÉGVÁRI, P.: What is the role of the far-eastern fish species in the life of lakes? — Answer: From, among the fishes got into the lakes the body-weight of increased threefold, on the other hand the body-weight of carps became tenfold in a year.

(22) M. MARIÁN has reported on the results of the Tisza research in 1976 and outlined the tasks of the next year.

Remarks and suggestions by the participants:

SZITÓ, A.: At the Tisza III river barrage. he suggested to build a proper and functioning fish-barrage

VÉGVÁRI, P.: He asks the fellow-researches for a many-sided investigation into the district of the Kisköre River Barrage from zoological, botanical, and other points of view.

BELICZAY, I.: He established that the far-eastern fish species would — as is to be expected — proliferate in the water of the Tisza, as well, because the zygotes could be exported on the feathers of the aquatic birds from some lakes.

TANÁCS, L.: He asks the Presidency of the Tisza-Research Working Committee to ask centrally the competent authorities for free admission of the research workers to the nature conservation areas.

The Conference ended with the presidential closing speech and evaluation of Dr. IMRE HORVÁTH.

Proposals compilated by the Presidency after Tisza-Research Conference VIII

The lectures delivered at Tisza-Research Conference VIII in Szeged, on 22—23 April, 1977, and the discussions following these, have raised several problems deserving attention from practical point of view, as well. There are some among the proposals of Tisza-Research Conference VII in Szeged, possessing present interest, as well: these are, therefore, repeated here.

(1) For solving the environment- and water-quality conservation problems of the Tisza, it would be necessary to create a regional laboratory. This should be organized in the vicinty of Tiszafüred.

(2) It is much to be wished that the National Water Office and other organs support as much as possible the exchange of working methods abroad of the experts of water management participating in the Tisza research.

(3) It is much to be wished that in preparing the great investments touching the Tisza (planning fish barrages to be built into damming plant weirs, etc.), also experts dealing with problems of environmental conservation (hydrobiologist, ecologist, etc.) take part.

(4) It is to be prevented with any means that herbivorous fishes get into protected waters (by building proper technical installations, etc.). It is desirable that the competent organs harmonize the economic interests with those of the environmental and nature conservation. And the decisions issued for conserving the purity of waters should be enforced.

In the course of the Tisza research work, in the future an increased attention should be paid to the following questions:

(1) The systematic investigation into the quality of water and the influence of tributaries on the water quality of the Tisza.

(2) Elaboration of the biological parameters suitable to determine water quality.

(3) Investigation into, and forecast of, the biological equilibrium of the reservoirs of major depth, to be expected.

(4) Water-body investigation in the complete Tisza stretch in Hungary and Jugoslavia.

(5) Investigation into the supposed prolification of the herbivorous fishes (amur) in the Tisza and its tributaries.

(6) Investigation into the efficiency of the Kisköre river barrage.

(7) Effect of a lasting water-covering on the living world of flood-plains.

(8) Effect of the agricultural pollution on the biological equilibrium of water.

(9) Investigation into the effect of water-speed upon the abiotoc and biotic parameters of water.

(10) At the complex investigation into each domain, we ought to strive to put into practice the increased co-operation of the experts working in various domains.

(11) We have to begin preparing the syntheses concerning all the problems and Tisza reaches, respectively, of which there are sufficient research materials at our disposal.

(12) It is an important task of the Tisza research, to promote forecasting the various human interventions for a longer time.

The compiler acknowledges with thanks the placing at his disposal the minutes made by Dr. M. Marián, Dr. Mária Hegedűs, and Dr. L. Tanács, for assisting him in bringing together the material of the Conference.

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FROM THE LIFE OF THE TISZA-RESEARCH WORKING COMMITTEE
TISZA-RESEARCH CONFERENCE IX

Compiled by

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The ninth programme of the Tisza-Research Conferences, becoming arleady traditional, was organized between 5 and 6 of May 1978. There were delivered 26 lectures, followed by animated discussions. The reports covering a wide field of researches were representing the cross-section of the scientific work in 1977.

The Conference began with the opening speech of Dr. IMRE HORVÁTH, professor and head of the Department of Botany in the University:

Ladies and Gentlemen,

I am opening our Tisza-Research Conference, in rotation the ninth. We are happy to see here the members of the working committee and our guests. I am specially greeting Professor Dr. MIHÁLY MIKES from the Institute of Biology of the State University in Novi Sad. His participation is so much the more welcome because it means that the co-operation in the Tisza-research, started last year, gets on the right way. We trust to bind the contract of co-operation with the State University in Novi Sad as early as in 1978 and thus the Tisza-research will also comprise the Tisza-reaches in Jugoslavia.

A similar co-operation was agreed with the State University in Užhorod (Ungvár). By means of these, the Tisza-Research covers the whole length of the river. Thus, our work becomes international.

In 1977, our Working Committee suffered a heavy loss. Dr. R. VÁMOS, lecturer of the University, one of the foundation members of the Tisza-Research Working Committee, died. (The participants of the Conference rendered homage to his memory by standing up for a minute).

As a preliminary, I should like to call your attention to two problems. These are: the connection between theory and practice, as well as the change of "life" of the Tisza. According to a Cabinet-decision in January, 1978, the material and spiritual resources of the research-development should be concentrated for fulfilling the socially, economically most important tasks. Utmost attention should be given to raising the level of the scientific research works establishing investigating-developmental tasks of direct economic aims and for increasing their effectiveness. This purpose is served by our activity carried out on all the three domains of research, enjoying priority.

The other thing I wish to draw the attention to, as to one of the basic principles of our research work, is the considerable change taking place in the life of the Tisza. To build reservoirs and follow the effect of their putting into service are important tasks of Tisza-research both in theoretical and practical relations.

We are pleased to be able to establish that the Tisza-researchers are prepared to a complex investigation of problems which are important to the practice, as well. This is proved, inter alia, by lectures, as well, to be delivered in our Conference of this year.

I wish every participant in the Conference a successful deliberation and good work.

After the opening speech of the president, and the exposition of the results of Tisza-research in 1977 and its tasks in 1978, the first part of the programme was continued with the lecture series "investigations performed in the district of the Tisza river barrages and in the nature conservation areas".

(1) ANDÓ, M.:

Climate types of the Tisza flood plain

The author systematizes the peculiar microclimatic fundamentals of the ecosystems of the flood plain on the basis of the microclimatic surveys performed for more than one year. He typifies size and character of the interactions taking place in the single natural-geographical sites. He analyses in detail the surface-climatic states formed in the area of forests, grasslands, mortlakes, dam systems etc, as well as the particular conditions of the heat- and light-climatic relations in the water space (of the mortlake).

The "Tisza flood-plain climate", appearing in the total effect of the single surface-climatic peculiarities — which is sharply separated in the climatic system of the Great Plain — has got a summarizing evaluation.

The microclimatic fundamentals of the single sites are typified by the author from the point of view too, of being utilized for recreational use, settlement, and other anthropogenous purposes.

Contributions to the discussion:

BÁBA, K.: He asks, why the month September is the driest in the Tisza-valley. — Answer: In late Summer, after the Tisza floods had passed as a result of the warm weather the flood pain becomes more and more dry, promoted also by the rainless September weather.

HAMAR, J.: Will the microclimate be changed in the district of Kisköre by the transformation of the macrovegetation? — Answer: A too much transformation cannot be reckoned with.

FARKAS, A.: What temperature conditions have developed in the different depths of the Tisza water? — Answer: As a result of the continuous water movement there did not develop any heat-stratification.

BÁBA, K.: What differences are between the microclimates of the middle-Tisza forests and the flood-plain forests in the environment of Szeged which can possibly exert an influence on the appearance or missing of the *Mollusca* species of montanic character? — Answer: According to the author's opinion the spreading of these Carpathian species cannot be influenced by the microclimatic differences.

ESTÓK, B.: Were there performed any meteorological observations in the recreational area to be developed in the Kisköre district? — Answer: Yes there were. But the direction of wind which is at present dominant n he itdistrict is NNW i.e. disadvantageous. It is most desirable, therefore, to form a convenient protective forest.

HORVÁTH, I.: Have the results of the two functioning meteorological stations shown a satisfying harmony? — Answer: Yes, they are in conformity with each other.

MARIÁN, M.: He is making inquiries concerning the temperature conditions of willow-plantations. — Answer: In case of plantations of closed stand a higher temperature can be observed in the tree stratum.

MIKES, M.: He asks if the investigations into the microclimate in flood plain contribute to develop the most suitable practical agrosystem. — Answer: Yes, they want to give answer to the question, what agricultural growing would be advisable in the flood plains within the comparatively short vegetation period.

(2) FERENCZ, MAGDOLNA:

Zoobenthos investigations in the area of the Tisza II river barrage

We have investigated into qualitative and quantitative changes in the zoobenthos fauna in the bottom samples, taken between 1969 and 1975, in the periods before (1969—1972) and after the impoundment (1973—1975) of the Kisköre Reservoir, from the Tisza (Kisköre and its district, Tiszaörvény, Tiszafüred) The Oligochaeta group was taken into special consideration.

It could be established in the course of evaluating the results that, in the period investigated, the number of Oligochaeta species (15, resp. 17), as well as their average individual numbers, were by and large in accordance with each other in both periods.

The highest average value of the individual number of Oligochaeta was found in the Small Tisza (10.6). The number was high enough in the Tisza Dead-Arm (7.5) and lower in the "living" Tisza at Kisköre (4.5), Tiszaörvény (3.2), Tiszafüred (2.7).

Contributions to the discussion:

BÁBA, K.: As a complement, in his opinion, the Molluscs, representing 28 to 30 per cent of the fauna of the Tisza, produce an equalizing process in this fauna together with the Oligochaeta.

ESTÓK, B.: What was the seasonal appearance of *Tubifex* like in the area investigated? At what a decrease in the dissolved oxygen content present themselves the problems at benthos? — Answer: *Tubifex* occurs in a rather low individual number. Concerning the seasonal changes, we have no data, as yet. He cannot give any answer about the change in oxygen content.

(3) ESTÓK, B.:

The hygienic microbiological investigation in the Tisza between Tiszafüred and Kisköre in 1975—1977

There took place a hygienic microbiological elaboration of profile and point samples between Tiszafüred and Kisköre, in the course of which a special consideration was taken for the pathogenic bacteria.

The performed investigations have unambiguously shown the section at Tiszafüred to be the most polluted *(Salmonella, Clostridium)*, as a result of the waste-water loading of the Tisza-stretch in Borsod. Going forward towards Kisköre, the bacteriological pollution decreases, primarily in the periods of river damming. At present, in these reaches, the manysided utilization of the river water can be solved with suitable technology. The investigational results of the river water, dammed up, give us an information concerning the natural clarification. But on the basis of these, the period after filling up cannot be prognosticated. Apart from preventive measures, the further bacteriological investigations are also necessary, to follow with attention the changes in the state of water.

Simultaneously with developing the recreational district, the regional canalization and water supply are also to be brought about.

Contributions to the discussion:

ANDÓ, M.: With what is to be explained that in the section at Tiszafüred the line of the current of water proved to be the most polluted? — Answer: As a result of the waste-water loading of the Tisza-stretch in Borsod, the most polluted water is forwarded by the line of current.

HAMAR, J.: In his opinion, the cause of the polluted state of the section at Tiszafüred may be the sewage-water of the town Tiszafüred, running into some kms above the section.

KISS, I.: He asks, from what depth the water samples originate — Answer: From a depth of 20 cm below the water surface.

MIKES, M.: How long does the pollution take an effect in the long run and how could it be neutralized? — Answer: Due to the natural water purification, a water scooping plant could be established 5 km below the introduction of the purified sewage-water. In Hungary, the solution of the purification of sewage-water is delayed by certain material problems.

B. TÓTH, MÁRIA: The number of pathogenous bacteria is negligible in the Tisza, as compared with the total bacterial count. Thus, they don't take any prominent part in the natural purification of water. She asks, whether there is any difference between the pathogenous bacteria in the periods of flood and low-water. — Answer: The pathogenous bacterial count of the Tisza is an important parameter. At flood, owing to dilution, a decrease in the number of pathogenic agents could be observed. There is, therefore, a considerable difference between the two periods.

HAMAR, J.: According to him, while at the natural water purifications the pathogens, because of their number, don't take any decisive part, in respect of water quality they are to be considered as a very important parameter.

MARIÁN, M.: Are the data concerning the salmonellosis of mallards the results of their own investigations? — Answer: The investigations were carried out not by themselves. He has primarily referred to literary data.

KISS, I.: How much has the pathogeny of *Salmonella* changed in the longitudinal section of the river? — Answer: They don't know it but in the next future they want to perform investigations of such character, as well.

HEGEDŰS, MÁRIA: As the Tisza water is no culture medium for Salmonella, a large number of them perishes after some time. But there may also occur survival occasionally.

(4) BANCSI, I., HARMAT, J., SZITÓ, A., B. TÓTH, MÁRIA, and VÉGVÁRI, P.: Longitudinal-section investigations in the Tisza (with projection)

Degree and role of the changes in water, and of the various external effects hitting the water body, are followed with attention in the continuous pursuit of a certain water body, i. e., with investigating into the longitudinal section.

From the results we have established that, in the formation of the quality of water bodies passing down the Tisza, a decisive part was played in the first place by the watercourse, the character and geochemical property of the vegetation of the watershed area.

The quality of water body — within this the chemical composition — was infiuenced primarily by the change in hydrological factors, first of all the decrease or increase in the speed of water flow and, simultaneously, the formation of the alluvial quantity floating in water.

Later on, the chemical and biochemical transofrmations in water, in the proportion of the single components, and the external effects hitting the Tisza (tributaries, sewage disposals, etc.), in their totality, have resulted in a qualitative and quantitative change in the chemical composition of water body.

By means of the investigations into the longitudinal section, the division of the river Tisza in sections, the influence of tributaries and sewage disposals, as well as that of river barrages exerted on the water quality, the temporal course of the biochemical processes inducing the actual trophic state of water, the decisive importance of watercourse and of the speed of water-flow became demonstrable.

In the course of the bacteriological investigations, carried out in the Tisza-stretch in Hungary, we followed with attention the formation of the total bacterial and total germ count of the river.

It is to be established that the bacterial flora of the Tisza, together with the floating matter content, changes in a more or less linear way in the longitudinal section of the river.

The total bacterial count of the Tisza is generaly high but in the single sampling sites the formation of values is highly influenced by the effect of hydrological conditions, tributaries, as well as barrages.

In our days, the river still has a natural purifying capacity to protect itself from the artificial impacts.

With algological investigations, there was evaluated the quantitative and qualitative dynamism in the longitudinal section of the Tisza, with special regard to the watercourse of the river, the change in its sectional character, and the analysation of the effect of tributaries and impoundments.

We offer a survey on the results of the investigations into Rotatoria and Crustacea living in the Tisza. The hydroecological conditions of the Tisza are analysed on the basis of effects exerted by the natural and artificial environmental factors upon the fauna.

In was ascertained by the benthos research performed during the longitudinal-section investigations of 1975 that in July and August the Tisza benthos is poor in Chironomida. The individual number of the mud-dwelling midge larvae increases only from the second half of September.

In 1977, in the course of the longitudinal-section investigation, from the 182 samples, there were only found 63 larvae, belonging to 13 species. Until Tuzsér *Rheocricotopus brunnensis,* till Tiszalök *Stenochironomus fascipennis,* while from Tiszafüred till the frontier of the country *Pseudochironomus albimanus* dominated. There was not found any animal in 95 per cent of the 182 samples.

In the course of elaborating the benthos samples, there came to light some Mollusca species, as well.

Contributions to the discussion:

P. Végvári's lecture:

ESTÓK, B.: What effect will exert the float conditions upon the water quality of the reservoir? What fluctuations on water surface can be expected at operating the resevoir? — Answer: The flood wave, carrying the largest quantity of float, will pass over the reservoir. In the initial period, we shall probably reckon with a minor filling up of the bed. In order to discharge floods sure enough, the reservoir must be emptied previously on more than one occasion. This will later mean 2 to 3 m fluctuations in water surface.

Mrs. ANTALFFY ANNA BOTHÁR: What is the effect of the single tributaries like upon the water quality of the Tisza? — Answer: Depending on, whether the materials dissolved in the water of tributaries are present in a higher or lower concentration than those in the water of the Tisza, they permamently increase or decrease (dilute) the solute concentration of the Tisza.

Mária B. Tóth's lecture:

ESTÓK, B.: Why does the river barrage reduce the number of bacteria in the impounded stretch? — Answer: As a result of impounding, water-speed decreases, the floating matter deposes. The total bacterial content of the river is in a close connection with the floating-matter content.

MRS. ANTALFFY ANNA BOTHÁR: What influence do the tributaries exert on the bacterial plankton? — Answer: By the Szamos it is considerably increased. The effect of the Sajó and Zagyva can be observed in the time of low water. The Maros, on the other hand, carries bacteria of major quantity into the river in the time of flood.

J. Harmat's lecture:

HORVÁTH, I.: The different organism develop in a different way in the stretches below and above the river barrages. He asks if this phenomenon may be attributed to physical or biological changes. — Answer: In the isolated water of the bay at Abádszalók there was always found a high total algal count. In August, it was superposed by algal bloom. The decrease in oxygen of the water layer near to the bottom was increased by the mass of blue-green algae. After algal blooming, the bacterial count is high.

MRS. ANTALFFY ANNA BOTHÁR: Can the seasonal dynamics of phytoplankton be demonstrated in the impounded stretch of the Kisköre River Barrage? — Answer: It can, but the dynamics of phytoplankton is decisively determined by the floating-matter content, as well. When the floating-matter is no limit, there manifests itself a positive correlation between the total algal count and temperature.

A. Szitó's lecture:

GÁL, D.: Did the larva of the "efflorescence of the Danube" occur in the Tisza, too? — Answer: In the period investigated, I did not find any larva of the Danube algal bloom in the sediment of the Tisza.

(5) SZŰCS, ERZSÉBET:

Water-chemical investigations into the Tisza Dead-Arm at Lakitelek, with respect to the aquatic vegetation.

I performed water-chemical and oxygen-carbon dioxide investigations in the about 6 km long north-eastern stretch of the Tisza Dead-Arm at Lakitelek-Tőserdő, in July and September, 1977, studying the connection of the daily rhythm of O_2—CO_2 flow with the degree of trophity and the aquatic vegetation.

The work was demanded by the regional reconstruction plan to be compiled for this area by the Tisza-Research Working Committee, as well as for supplying data to the Kiskunság National Park.

Sampling lasted for 24 hours each, every 6 hours, in three places of the dead arm.

On the basis of investigations, it is to be established as follows:

1 — In the sampling place, at the north-eastern end of the dead arm (with a completely closed macrovegetation) strong decomposing processes continue. Simultaneously, eutrophication reaches also a high level.

2 — In sampling site 2, in the middle section of the dead arm (with a macrovegetation of 30 to 40 per cent cover) eutrophication and saprobity are of medium value.

3 — In sampling site 3 (open water surface), it is shown by the values measured above the inflow of the water of Tősfürdő that in this part of the dead arm the aquatic ecosystem is still in state of equilibrium.

Contribution to the discussion:

VÉGVÁRI, P.: It was mentioned in the lecture that the dominant ions of the water of the Tisza Dead-Arm at Lakitelek were sodium and magnesium. After flood, however, the calcium ion predominated. Was later on, anyway, the dominance of the sodium ion re-established? — Answer: Analysations in this direction were later, unforunately, not carried out.

B. TÓTH, MÁRIA: In her opinion, the strong morning decrease in the dissolved oxygen content is supposedly a result of the respiration of the rich zooplankton and phytoplankton to which there contributed also the activity of mud. — Answer: He agrees with this completion.

KISS, I.: He explains the increase in the sodium and magnesium content with that sodium, and together with that magnesium, appear in the water of dead arms in a large quantity as a result of chemicals contained in the sandy soil of Kiskunság reaching up to the Tisza. The chemism of water may exert in many cases an influence upon the formation of the aquatic macrovegetation.

(6) BÁBA, K.:

The Mollusca fauna of the Tisza, its research situation and tasks

Mollusks are important water-filtering organisms and fulfill a considerable part in feeding our useful fishes. It is therefore of no minor interest, to study the effect exerted by the reservoirs under construction and that of the inflowing sewage-waters upon mollusks.

The formation of the Mollusca fauna of the Tisza can be understood on the basis of the history of changes in fauna. The climatic change after the Pleistocene Epoch and the river control brought about mainly quantitative changes in the composition of the fauna. The changes of the present induce a slow impoverishment, primarily in the vicinity of the inflow of sewage-water. The Mollusca fauna is transformed quantitatively and qualitatively by the rather intensive paving of riversides and the reservoirs.

There occur 40 per cent of the 67 aquatic mollusk species of Hungary in the Tisza, 55 per cent in the dead arms, 34 per cent in the borrowing pits. The horizontal and vertical distribution of Mollusca is influenced by the vegetation and abiotic factors (light, current speed, quality of the bottom, and the building or destroying activity of the riverside). The dead arms, borrowing pits get supply by the species transported by means of the flood. The upper, middle and lower reaches differ regionally, in the first place, by the dominance relations of Mollusca.

By putting the Tisza II River Barrage into operation there ensue qualitative and quantitative changes. It is to be expected mainly a rapid breeding of species tolerating slower watercourse and silting and of those liking the vegetation along the riverbanks.

The malacological research work should also be extended over the Upper-Tisza and the tributaries which are completely unknown, as well as to the quantitative surveys of energy flow in the district of the Tisza II River Barrage.

Contributions to the discussion:

ANDÓ, M.: Why did the individual, resp. species number of Mollusca decrease so considerably in the area of the "living" Tisza as compared with the regions of flood plain? — Answer: Before river control, the flow of the Tisza was slower, it was richer in food and its translucence was also greater. As a result of the change in the original state, its characteristic changed. This was of a negative influence on the Mollusca fauna of the Tisza.

GALLÉ, L. JR.: Why do snails take place in the reaches overgrown by vegetation? — Answer: They use these primarily as a dwelling-place because they are not specialists in feeding.

BODROGKÖZY, GY.: How varied is the distribution of snails according to plant associations and why? — Answer: It is proved by the investigations in this field that there is possible the formation of as many species combinations as there are plant associations.

HEGEDŰS, M.: Did the lecturer intend to perform a toxicological investigation into the snails? — Answer: He has not performed, as yet, investigations of this direction.

HAMAR, J.: Does a snail population live in the current line of the Tisza, in the deepest parts of the river? — Answer: *Lithoglyphus* sp. naticoides can probably be found.

B. TÓTH, MÁRIA: She asks with what means the satisfactory sample can be taken in the sections of deeper water. — Answer: A good sample material for the investigation can be collected by diving. But with Eckmann's sampler a good bottom sediment can be obtained even from 6 m depth.

MARIÁN, M.: Dreissena polymorpha has been known as a species damaging other mollusks. How long did it get up in the Tisza and is damaging there? — Answer: At present, it is one of the most wide-spread species of the Tisza. But we are still waiting for its systematic investigation.

(7) BODROGKÖZY, GY. and HORVÁTH, I.:

Succession of marshland associations in the flood plain

The flood plain of the Tisza is systematically covered by spring floods and flood-free years only rarely occur. The continuance of water-cover is, however, different. In case of lasting covering, the composition and zonation system of the meadow associations considerably changes. This can also be observed well in case of the *Lythro (virgatae)-Alopecuretum* stand occurring in the highest places of flood plain, after the long water covering of 1974. As a comparative control, we have chosen the conditions of the for more years comparatively waterfree period of 1952 when, apart from *Alopecurus, Agropyron* repens had the leading role in this stand and the total covering of the other species was insignificant.

In 1974, as a result of the continuous water covering, lasting from the beginning of the year until September, its stand became devested. In 1975, a regeneration began but it was considerably thrown back by a newer flood in the next Spring. In the Summer of 1976, the stand was more and more closed. The hydatophytes *Carex melanostachya* and *C. gracilis* have, however, in respect of the dominance relations and the overground phytomass production, far preceded the hydrophytes, among them *Alopecurus pratensis*. The culmination time of their closing and output curves fell on the middle of July.

During the growing season of 1977, the habitat conditions of the speargrass zone became gradually drier. As a result of this, the competitiveness of the *Carex* species decreased. And the regeneration of *Alopecurus*, the reacquisition of its dominant role was considerably impeded by the fast and considerable spreading of the extremely virulent *Glycyrrhiza* and *Lythrum* species.

From economic point of view, this change is important baceuse, as a result of the lasting water covering, the willowy-speargrassy marshlands become sedgy, followed by the transitional weediness of the grassland.

Contributions to the discussion:

ANDÓ, M.: In his opinion, there are in the first place the surface and sub-surface waters which have an effect on the single associations.

HEGEDŰS, MÁRIA: She wanted to get an answer to the question what differences are, classified by size, in the organic matter productions, between the for a long time water-covered and the less wet areas. — Answer: The organic-matter differences between the associations are not fixed here between associations by the quality of soil but the hydrographical conditions. As a result of being water-covered, the *Carex* species take place even in areas of higher relief and the quantity of organic matter raises In a dry period, *Alupecuretum* can reconquer its original area only after a longer time and this process alters even the size of organicmatter production.

MARIÁN, M.: According to him, the material of lecture is a good basis for those dealing with mollusks and mites. He is suggesting a better co-operation between the investigators of these research fields. It is most desirable to convene even a round-table conference for trying to harmonize their work.

(8) MARGÓCZY, KATALIN:

Plant-ecological investigations into the Tisza Dead-Arm at Lakitelek

The Tisza Dead-Arm, lying on the confines of the village Lakitelep, and its environment forms of the blocks of the Kiskunság National Park. In the forests bordering the dead arm, I performed coenological and ecological investigations in

July and September of 1977. My aims were: a detailed botanical description of this block of the National Park and the promotion of the regional reconstructive plan to be made by the Tisza-Research Working Committee.

The investigations were carried out in there stocks of the gallery forest of flood plain. In the sotck of lowest stratum along the water the dominant species was *Salix alba,* in a higher stratum *Populus alba,* and in the places of highest situation *Quercus robur.*

The coenological recordings — determining covering and height of reliefs of the association — were carried out in 4 to 6 repetitions. The distribution of growth form and floristic components was calculated.

It can be established on the basis of investigations that:

1 — The anthropogenous influence is considerable in all the three stocks. Nevertheless, the natural renewal of *Quercus robur, Ulmus minor, Fraxinus angustifolia* and *Alnus glutinosa* sporadically occurs in the shrub stratum of the young plantations.

2 — The original underwood in the shrub stratum was in many places considerably forced back by *Amorpha fruticosa,* "dense as a brush".

3 — In all the three stocks, in the herb stratum, *Rubus caesius* and *Aristolochia clematitis* are the dominant species. By *Vitis riparia* ,climbing up trees, the whole stock is often woven "jungle-like".

In spite of the cultural effects, Tőserdő often reminds us of the landscape along the ancient Tisza. There occur in it some rather valuable plants like *Leucojum aestivum, Arum maculatum, Urtica kioviensis, Iris pseudacorus,* and even *Fagus silvatica.* Protection is therefore justified by the rich vegetation of the dead arm, as well. The possibilities of recreation and relaxation could also be enlarged by nursing carefully the forests along the dead arm.

Contributions to the discussion:

MRS. F. ANTAL She would like to get answer to, what their proposal about region reconstruction contains; what kind of *Fraxinus* species took place in the lecture; what the closing of oak-plantation was like, and what geophyte species took place both in the poplar- and in the oak-plantations. — Answer: The restitution of macrovegetation should take place by planting species, fitting in the region; it is also necessary to recontsruct the animal kingdom. From among the ash species, *Fraxinus angustifolia* occurred in the area; the closing of oak-plantation must have been 60 per cent. Concerning the geophytes, she can only give an exact information after looking into her Tables.

HAMAR, J.: He regards the reconstruction of the ancient forest stocks of the region as a difficult task, because the execution of plans is aggraveted by the mass distribution of *Amorpha.*

GALLÉ, L., SR.: He makes an objection against that the investigations did not comprise the moss and mushroom strata of the forest. He asks if the lecturer has not observed any major lichen-colonies on the tree-trunks of the forest investigated. — Answer: The investigations have primarily comprised the flowering plants of the herb stratum.

ANDÓ, M.: In his opinion, the region reconstruction is aggravated by missing of a suitable bank of genes. In these areas, the renewal of the ancient forest stocks will not follow. The climatic conditions are not suitable for that, either.

BÁBA, K.: Accordig to him, the picture of fauna indicates that this area became drier. The spreading of *Amorpha* could also be reduced by inducing a higher ground water.

(9) HALASY, KATALIN; CSOKNYA, MÁRIA; STAMMER, ARANKA, and HORVÁTH, I.: Respiration-studies on *Palingenia longicaude* larvae of different developments

The authors have studied the effect of internal and external factors modifying the oxygen consumption of larvae. They have established that the respiratory values of the larvae of young age are higher, owing to the intesive metabolic processes — particularly to the vivid motion.

From the external factors, they emphasize the underwood and water flow which are factors changing the intensity of respiration, in close connection with the habit of larval life, as well. They support the significance of the underlying soil by the values measured in case of aplying the so-called "ideal substratum".

The Q_2 values are increased in every group by the temperature of water (until about 20 °C).

Owing to the negative phototaxis of larvae, light evokes a strong place-changing motion, increasing by this the intensity of respiration.

Contributions to the discussion:

GALLÉ, L., JR.: As respiration means consumption of energy, we should also know the organic matter content of mud. Can that be measured? — Answer: Investigations in this direction are only planned for the future.

BÁBA, K.: He asks whether the larvae, indicated according to weight classes, were in an uniform state. — Answer: The age of life was determined on the basis of weight classes which meant a well-separable state of development supported also by histological investigations.

MAGYAR, L.: Where were found the may-fly larvae? — Answer: These could be found in a more than one metre depth in the Tisza-stretches below the inflows of the town sewage-waters.

HORVÁTH, I.: It is a tradition of past years that we would greet the lecturing colleagues, delivering their lectures in our Conference on the first occassion. In this way, we are greeting now affectionately our colleagues KATALIN HALASY, KATALIN MARGÓCZY, ERZSÉBET SZŰCS, MÁRIA B. TÓTH, and B. ESTÓK, wishing all of them further successful work.

(10) MAGYAR, L.:

Nutrition-biological investigations in the artificial nesting-box colony of the forests in the flood plain at Mártély-Körtvélyes, *Parus* farmstead

The author is presenting the result of four years long experiences in respect of arranging artificial nesting-box colonies, in particular consideration of the effect of the Tisza water-level.

He has found connections between other factors influencing the density of population.

He makes known the results of the bromatological investigations till then in respect of feeding the youngs of three species of the nesting-box colony, *Parus maior*, *Parus coeruleus*, and *Passer montanus*.

He establishes connections between the quality of the supplied food, the density of next boxes, the tree-stock of the forest, and the water-level of the Tisza.

Contributions to the discussion:

MARIÁN, M.: He asks in connection with the lecture of ornithological subject-matter why the dwarf-acacia (Amorpha fruticosa) insectifuge is and if it is possible to introduce nesting boxes into the *Populus* stands, too, in the future. — Answer: There are, anyway, no literary data about the insectifuge property of *Amorpha* fruticosa but the effect of this is based on his own concrete experiments. It is to be supposed that this shrub may excrete some aromatic, insectifuge matter.

GALLÉ, L., Jr.: What's the wrong in that the tree-sparrow is present in these areas? — Answer: It is to be desired that in the nesting boxes, placed out, tomtits nest because these are forest dwellers during the whole year while sparrows leave the area after nesting. In case of floods, these forests are visited by deers in large numbers. Their hair cast-off serves as an exclusive primary material of the nests of tomtits.

HAMAR, J.: In his opinion, it is wrong, to introduce birds into the natural forest stands. It is right, to place out nesting boxes only into artificially planted stands. — Answer: These forest stands have a very large number of parasites. These, multiplying, swarm into other cultures, as well, and damage these. It is to be wished, therefore, to place out as many nesting boxes as possible. The smooth trunks and boughs of Canadian poplars are unfavourable for building nests, here it is therefore necessary in an increased degree to place out nesting boxes.

BÁBA, K.: Do floods not influence the introduction of birds? What was like in the area investigated the proportion of appearance of blue tit and tom-tit? — Answer: After the flood of 1977, the nesting boxes became suddenly more populated.

II Investigations carried out in other Tisza-stretches

(11) MRS. KEMENES KLÁRA FÜGEDI, MRS. I. HOVORKA, and MÁRIA MÉSZÁROS: The damaging effect of the water Kurca on horticultural plants

The chemical pollution of our canal system of double utilization may have a damaging effect on the watered cultivated plants.

At our experiments we have applied the water of the river, resp. channel Kurca polluted with chemicals, under natural conditions. We used it as irrigation water in a period when the herbicide agents of Dikonirt: 2.4—D—t (0.16 mg/l and phenol could be demonstrated from it in the highest concentrating. The effect of the water was investigated in the seedling pumpkin. Investigating into the indices of metabolism of the plant (enzyme, protein, etc.), we have established that in this concentration the phenol-induced delayed growth was not damaged by 2.4—D. Applying the same chemical concentration to plants in quadrifoliate state — and performing our observations on the basis of the indices investigated by us — we came to know that the plants were damaged until falling in economic value, resp. even being perished, by both 2.4—D and phenol.

The water of the Kurca, applied to irrigation, damages the plants of soft stalk both in their biological and economic values.

We also endeavoured to establish with experimental method, how long the active constituent of the herbicide remains unchanged, under irrigated conditions. It was ascertained in our growing-vessel experiments that it makes its effects felt for about 70 days, and this is proved by the investigated metabolism indices, as well.

Contribution to the discussion:

BODROGKÖZY, GY.: In the irrigating water, the sodium content proved to be of identical value. At a high value like this it could be expected that even sodium itself is damaging the experimental material. He asks, when these investigations took place and if there is any considerable change in the composition of water. — Answer: In the water of the Kurca, going towards its mouth, the sodium content increases; it is considerably higher than that obtained in the investigation. In these reaches, therefore, the water of the Kurca is no more suitable to be used for irrigation.

HORVÁTH, I.: He has only so much to add that the lecturers have investigated a question which is highly important and well utilizable even for practical purposes.

(12) VÁNCSA, A. L.: Changes in the degree of trophity in the Sajó, between 1965 and 1976

In the water-quality economy of Northern Hungary the Sajó — the changes of which in trophity-degree I have qualified with the results of the algological investigations performed since 1965 — is a water-course of outstanding importance.

From the 869 water samples 727 originate from the river stretches which are suitable for characterizing the changes. The algological investigations were carried out from drawn water samples. The comparative evaluation of these took place on the basis of the total algal litre number. At characterizing these the 1×10^6 ind./lit. value was considered as a limiting value. For characterizing the changes in the degree of trophity, a satisfying possibility is given by the average of the maximum, minimum total values and that of the million values but the incidence of all the algal litre-number values of a million order also proved to be a good index.

It is indicated unambiguously by the changes along the longitudinal section that the trophity of the Sajó in the river section below Miskolc is growing and in the short river section before the mouth this is expressly a sudden change. The causes of this may primarily be the following effects (possibly collectively):

(1) The natural (self-) purification of the Sajó is of a tisfying degree and, therefore, the quantity of the dissolved vegetable nutritive materials is also of increasing extent.

(2) From the sewage farms, functioning at the water system of the Sajó, more dissolved vegetable nutritive materials get into the Sajó and its tributaries respectively.

(3) There is also the amount of the dissolved vegetable nutritive materials — originating from agricultural activity and runoff from the watershed area of the Sajó — in the Sajó and its tributaries, of increasing degree.

Apart from characterizing the water quality of the Sajó, the results of the investigation can be utilized well in protecting the water quality of the Tisza, as well.

Contributions to the discussion:

HAMAR, J.: The Sajó may be considered as a polluted water. The quality of its water is strongly going towards being of saprobic character. Is this supported by the investigations? — Answer: Yes, it is. The algal count in the vicinity of its mouth is uniformly increasing.

VÉGVÁRY, P.: Is it imaginably that coming near to the mouth, the strongly increased trophity degree is also to be explained by the flowing speed being slower as a result of damming? — Answer: It is imaginable, but to decide this it will also be necessary to evaluate the results of investigations in the last years.

HORVÁTH, I.: He asks if the influence of the Sajó could be demonstrated in the Tisza. — Answer: We have had no investigations into this direction, as yet.

(13) HEGEDŰS, MÁRIA and Mrs. L. DOBLER:

The comparative microbiological investigation into the stretches of the Triple-Kőrös and Maros in County Csongrád

The water quality and water type of the rivers Triple-Kőrös and Maros can be distinguished from those of the Tisza by their origins and watershed areas. Both tributaries were systematically sampled since 1975. In the last three years, from the two water spaces about 123 water samples were taken and approximately 1700 investigations were carried out. The Triple-Kőrös was sampled at river-km 2, and the Maros before flowing into the Tisza and in the district of the bridge in Makó. From the water samples, bacteriological and biological investigations were performed.

In the lecture, the results of investigations in the last three years are outlined. Within this, we speak in more details of the change in the hygienic bacteriological parameters, the hygienic water quality. On the other hand, from among the biological investigations only the changes in saprobity and trophity are discussed.

It is to be established on the basis of the results of the complex investigations that in the last three years, the water quality of both rivers deteriorated by one class.

Contributions to the discussion:

SZITÓ, A.: The water of the Maros, owing to its pollution, is therefore not suitable for irrigating vegetables. But what happens if it is none the less used for watering? — Answer: It has, as yet, not been forbidden, to use a water, like this, for watering.

HAMAR, J.: Is the cause of the polluted state of the Maros known or can it be possibly ascertained? — Yes, it is known. The Maros suffers a considerable pollution even in its Hungarian stretch, mainly in the area of Makó.

HORVÁTH, I.: Are the waters getting into the Maros duly purified? — Answer: The sewage-waters getting into the Maros are generally purified but the degree of purification is not always satisfying.

BÁBA, K.: In what degree has the pollution of the Maros an effect on the open-air bath in Szeged? — Answer: The water of this bath is considerably influenced by the Maros. In this the unfavourable localization of the bath has also a part.

KISS, PIROSKA: She considers the exposed results of the bacteriological investigations as highly important. As a complement, she mentions that 5—6 years before the salmonellosis could not be demonstrated from the water of the Tisza. At present, however, as it appears from these facts, it can already be demonstrated from this river, too. The animals in the vicinity were namely infected by foods made of basic materials from abroad with a not proper manufacturing process. Salmonella has got into the sewage-water with the secretion of animals and later on into the "living" waters. Its occurrence being increased, a water like this can endanger human life, as well. — Answer: It is proved by the results of investigations that, as *Salmonella* is present in the waters attached to the floating matter, ofter a single gulp is enough to get infection.

HORVÁTH, I.: We shall inform the proper authorities of our conceptions concerning the investigations in connection with *Salmonella.*

(With this, the first-day programme of the Conference was completed)

On the 6th of May, lectures were resumed according to the programme.

(14) KISS, I.:

Eutrophication of the dead arms at Cibakháza, Csongrád, Tiszaug, and Alpár in the mirror of the algal flora and algal vegetation

The investigation into the algal flora and algal vegetation of the four Tisza Head-arms, carried out in 1975—1976, shows an increasing eutrophication. The number of algal species, being fond of the waters rich in nutritive materials, increases more and more. The "algal blooms" and other algal mass production inducing vegetative colourations become more and more frequent.

There seems to be the most polluted by organic matters the eastern branch of the dead arm at Cibakháza, in some southern sections of which the species of beta and alpha-mesosaprobic character are dominant. The section close to the village is less polluted. Here grows *Ceratium hirundinella* in large numbers, even in the deeper places along the riverside. The "efflorescence of water" of quent particularly in the south-eastern section.

The stretch of the dead arm at Csongrád, close to the town, is also considerably polluted and the mass production of *Microcystis, Anabaena,* and *Anabaenopsis* could also here be observed very frequently. It could be established here in several cases that the trichomata of *Anabaeba* were divided into planococcus-cells, forming clusters of *Microcystis*-character.

The dead arm at Tiszaug is rich enough in phytoplankton and is exploited for fishing, as well.

The part of the dead arm at Alpár close to the village is the most eutrophicated. Among the Euglenophyta speies *Phacus helicoides* also appeared on more occasions. In the muddy sites, *Spirochaeta plicatilis* and some sorts of *Spirillum* occurred, as well. The shallow waters in the places of turf-cutting are less rich in algae.

Contributions to the discussion:

SZITÓ, A.: In fishing waters, 6 to 8 kg fodder is suggested for supplying the single areas. A large amount of maize getting into the water may cause algal bloom. The fish-ponds are supplied with manure, too. As the maize as a food is poorly digested by pigs, this farmyard manure, getting into the water, may continue increasing the algal production.

HEGEDŰS, MÁRIA: The author has not found the sewage-disposal at Cibakháza because in hog-farms drainages are applied. The oozing-through into the dead arms is, therefore, to be supposed. — Answer: Oozing-trhough is, in his opinion, not probable. The invasion of sodium carbonate and bicarbonate, resp. magnesium can be attributed to the surrounding alkali soils. The poor food utilization of pigs may really take part in the increased algal production, mentioned by A. SZITÓ.

(15) Mrs. L. DOBLER and MÁRIA HEGEDŰS:

Data to the water quality of the dead arms along the Tisza. The dead arm at Serházzug and Alpár

We began the complex investigation into the water quality of the dead arms at Alpár and Serházzug in 1976. Water samples were taken monthly, at a site each, from below the surface, and there were carried out 280 investigations. On the basis of the results of the bacteriological investions, the degree of pollution was registered.

The biological investigations comprized the whole of the property groups of the biological water qualities.

At present, we only render an account of changes in saprobity and trophity degrees.

The knowledge of the water quality of the dead arms utilizable in the district of the Water Administration of the Lower Tisza Region, as well as the protection of their present state, continue to be our task of high-top priority.

Contributions to the discussion:

VÉGVÁRY, P.: Which of the two dead arms was inundated by the Tisza in the time of floods? — Answer: None of them, because a breach in the so-called protective summer-dams occurs only rarely.

(16) GÁL, D.:

Effect of waste-waters of the industrial plant in Szolnok on the zooplankton of the Tisza

From the point of view of the quality of water of the Reservoir, to be formed above the planned Tisza III River Barrage, the waste-water getting into the Tisza from the industrial units in Szolnok cannot be indifferent. On the basis of the several years long investigations until now, the zooplankton of the river is considerably changed by the waste-waters flowing in below Szolnok. This effect goes on increasing in the reservoir owing to the slackening of the speed of water-course.

The zooplankton of the water mass getting to Szolnok agrees quantitatively and qualitatively with the zooplankton composition of the similar reaches of the Tisza: in the zooplankton, Rotatoria species are dominating (about 55 per cent of the total zooplankton). The Entomostraca species are forming about 30 per cent, the Protozoa 10 per cent or so of the zooplankton. A few further per cent ages are composed of the representatives of other groups (Nematoda, Tardigrada, larvae, etc.). The dominant species are characteristic of beta-mesosaprobic waters (about 45 per cent of the zooplankton). The alpha-mesosaprobic organisms generally occur in lower individual number (20—25 per cent).

The Zagyva carries already a considerable quantity of waste-water into the Tisza (in the first place, the waste-water of the sugar-works in Hatvan). Then there flow the waste-waters of different quantity and quality from the town sewage-disposal, the slaughter-house, paper-mill, sugar-works, and chemical-works into the Tisza. Under the joint influence of these, the amount of the total zooplankton is generally reduced to a half, but often to a quarter, of that above Szolnok. At the same time, the qualitative composition also changes: there predominate mainly the alpha-mesosaprobic organisms (about 55 per cent), forcing back the beta-mesosaprobic organisms (about 20 per cent).

The degree of pollution is also shown by that the composition of zooplankton is re-established only below Csongrád (after more than 90 river-km) into its original state which is characteristic of the Tisza.

Contributions to the discussion:

JÓSA, Z.: It turned out of the investigations between 1960 and 1970 that the water of the Zagyva with algal bloom brought about 50 per cent or so change in concentration after the mouth, by which there are touched mainly the Ciliata. The neutralizing equipment of the sulphuric-acid factory is functioning efficiently. It is namely not showing any negative effect at the inflow. The river does not reach even at Vezseny the beta-mesosaprobic degree.

HEGEDŰS, MÁRIA: The water at Szolnok is not suitable for being used as drinking-water. We called the attention to this as early as in 1965. — Answer: He thanks for Z. Józsa's completion and notices that the residents in Szolnok get drinking-water from the river section above the city and it still does not reach the demanded degree of purity. Its saprobiological index is much above 2.

(17) JÓSA, Z.:

The role of protozoological investigations in the Tisza-research

As a result of the more and more increased development of industrialization and urbanization, in more and more countries, one of the most urgent problems is the pollution of river-waters. It is, therefore, one of the most important tasks of the Tisza-research, to investigate into the pollution of the river. The pollutions by chemicals are established in the way of chemical investigations.

From the point of view of getting drinking-water, bathing, as well as from that of the food chain and the stock of fish, the organic-matter and bacterial pollution of the river is important.

A great many Ciliata species are detritus- and bacterium-eaters. Certain Ciliata species are excellent indicator-organisms for ascertaining the saprobia-degree of water. Thus, the appearance of some Ciliata species of polysaprobic or katarobic character in large numbers is definitely indicating the degree of the pollution of water or even its purity. There are particularly important some Ciliata species as bio-indicators, for indicating the Tisza sections with alpha-saprobiontic, as well as oligosaprobiontic and katarobiontic water. The investigation of the Ciliata species is, therefore, important not only from taxonomical, coenological, and physiological points of view but also from ecological and saprobiological aspects.

The bacterial pollution can be ascertained the most decisively just with biological (protozoological, algological, and bacteriological) investigations, and it is advisable to perform these parallel with the chemical investigations.

Contributions to the discussion:

GÁL, D.: The number of species which are characteristic of certain degree of saprophyty is, as a matter of fact, low. This also shows the weak point of the saprophytic system. On the basis of Rotaria alone, the water of the Tisza can be deemed to be of very good quality. This value is counterbalanced by Ciliata.

HORVÁTH, I.: He asks, if there is some microtechnical method to perform nutritionbiological investigations. — Answer: The quality of water is best indicated by bacteria as a meso-zooplankton. It would be difficult to excise and stain the digestive vacuole. This task is made still more difficult by that food is fragmented in vacuoles.

GALLÉ, L., Sr.: What may be the cause of the diurnal changes in pH of the Tisza? — Answer: The cause of pH-changes is not cleared up but it may also be a problem of oxygenation. The morning state is generally re-established at night.

VÉGVÁRY, P.: In his opinion, the pH values are determined by the arriving water bodies. In river stretches of small water it can primarily be influenced by the relation O_2—CO_2. He asks whether the Ciliata fauna—if it is bactericidal — consume the bacteria, too, which decompose organic matter. — Answer: In purifying water, first of all the Ciliata species take a part. Besides this activity of these, the damage caused by consuming even the decomposers is negligible.

KISS, I.: The food chain does not hold in respect of alkali waters. In case of algal bloom, the bacterial and Ciliata planktons are missing. They only appear after the algal blooming. In my opinion, the bacteria exposed out of the digestive vacuole cannot be determined concerning their species because they are already attacked by the digestive enzymes and their character has, therefore, changed. — Answer: János Horváth has dealt much with micro-operations. The nuclear operations were successful, those of the digestive vacuoles, however, were not. The content of these has immediately mixed, namely, with the cytoplasm. The animal of about 200 μ size is so small that the equipment we have is for this task at present still unsuitable.

(18) STAMMER, ARANKA; HORVÁTH, I.; CSOKNYA, MÁRIA; and HALASY, KATALIN: The differences between the structures of swimming-bladder in Tisza fishes

We have investigated into the light-, scanning-, and electron-microscopic structures of the (in the evolution more ancient) open, and the newer, closed, swimming-bladders, in the species carp *(Carassius carassius)* and pike *(Esox lucius)*, resp. perch *(Perca fluviatilis)* and silky ruff *(Acerina Schraetzer)*.

The difference between the oxygen-producing red corpuscle and the oval opening, ensuring the connection with the external blood circulation, is the most obvious. The red corpuscle is a capillary network, formed from the vasculature of tunica intima, having a larger size and denser structure in species of closed swimming-bladder than in those of open swimming-bladder.

The capillary wall is built of endothelial cells of strongly vacuolic plasm, with pericytes on them of darker plasm and longitudinal nucleus. The capillaries, poor in nerve-fibres, have supposedly a humoral regulation. The smooth-muscle ring of the oval anterior ventricular opening, lying on the descending aorta dorsalis, functions with a rich neural plexus.

As a result of the hydrogen-sulphide pollution, the cells of the closed swimming-bladder are damaged but much later and only at a pollution of stronger concentration than the capillaries of the open swimming-bladder.

Contributions to the discussion:

JÓSA, Z.: He asks, where the gas-production takes place. — Answer: The gas-production is supposed by a number of researches but it is difficult to decide in this question. The capillaries closely adhere to the epithelial cells. The connection, supposed in literature, does not exist but only a simple diffusion. Oxygen gets into the swimming-bladder through capillaries. We have investigated in details even its chemical relations.

MIKES, M.: In the course of evolution, the secondary formation of the terrestrial life is probable — as emphasized by the lecturer, as well.

(19) GASKÓ, B.:

Cerambycides of the southern Tisza-valley

Contributions to the discussion:

GALLÉ, L., Jr.: The fauna-mediatory role of the Tisza at other animal groups is proved. Is there any for where the non-steppe species come from into the Tisza valley. — Answer: A fauna-spreading effect of rivers is imaginable if the necessary food is available. A tree-trunk can, e. g. flat down from the upper river reaches, as well. But apart from the transport by flood, the rai, way transport can also be taken into consideration.

MARIÁN, M.: Are the long-horned beetle species heterophage? — Answer: They are bound to a active ingredient and not to a determined species of trees.

(20) GALLÉ, L., Jr.:

The ecological energetics of *Formica cunicularia* LATR. in herb associations along the Tisza

Formica cunicularia is the most frequent *Formica* species of the Tisza-valley, the density of its nests in the floodfree grasses of the basis-areas of the Tisza-research is of size 10^{-2} nest/sq. m. Applying to the analysis of the flow of energy of nests the formula, proposed by the IBP:

$$C=P+R+FU$$

the flow of energy of an average colony is characterized in percentile terms by the correlation:

$$100=2+79.5+18.5$$

The respiration, taken as a function of temperature, is showing a logistic correlation.

The flow of energy is influenced by the social way of life because:

(1) The value of respiration: $1\ mg^{-1}\ h^{-1}$ depends upon the individual number in the respirometer:

$y=1.1+10.018+0.67x$;

(2) The consumption of the colony (C) is inversely proportional to the size a colony;

(3) The ratio 2 per cent P/C, obtained in the relation of the colony, is low as compared with another poikilotermic organism. At the level of the individual it is, on the other hand, 24.96 per cent, corresponding to the ecological efficiency of the poikilotermic predators.

The daily consumption of colonies is of size $1—10^2$ mg $(10^1—10^2$ cal). This follows mainly from a secondary consumer-functioning. The key-activity of F. cunicularia in connection with the flow of energy is, as a result of ratio 79 per cent R/C, the release of the energy accumulated in biocoenosis.

Contribution to the discussion:

KISS, I.: He asks if the belief that the ants indicate the approach of raining by their motion in large numbers at the surface of ground is established. Can be the effect be explained by that, in the given space, the animals are near to one another and so their possibility of movement is smaller? — Answer: In Hungary, 85 ant species live. The indication of approaching raining could only be observed at a single species, and even that is not unambiguous. They only move animatedly at the optimum 25—28 °C at the surface of ground, but there may occur some difference, as well. This depends upon the individual properties of the community. A decrease in motion follows partly owing to the reduction of space, partly due to the fermon- and ethological effect.

B. TÓTH, MÁRIA: What is the effect of pesticides on ants? — Answer: The effect of chemical fertilizers on the ant population is of reducing character. Concerning other fertilizers, we have but a little investigational material. They unreally perish even under the influence of pesticides of small amount.

CZIZMAZIA, GY.: From the rook-colonies, the birds often visit the ant-hills and turn these up, then sit into them. What may be the cause of this? — Answer: It is probable that ants pick out the lice from the feather of rooks. It is imaginable, too, that with ant-bites they bring in formic acid into the body of rooks. This exercises have namely a pleasant, refreshing effect.

MARIÁN, M.: How is possible to calculate the ant population per hectare? — Answer: The colony-density is generally estimated. In case of major colonies the estimation may take place by overlooking the soil surface carefully, in case of minor ones by exploring it.

(21) TÓTH, S.:

Characteristics of the Syrphidae fauna of the Tisza-valley

The collection of Syrphidae has taken place in the framework of the Tisza-Research since 1959. In the course of work, a round 100 species could so far be demonstrated from the Hungarian stretch of the Tisza-valley. This number is supposedly one-third of the Hungarian fauna. On the basis of the experiences until now, in our mountainous areas the Syrphydae fauna is considerably richer. The missing of *Cheilosia* species from the Tisza-valley is particularly striking but this is probably characteristic of the whole Great Plain. At the same time, the fauna is, of course, richer in some species the larvae of which develop in water.

There are 23 among the demonstrated species, the mass participation of which exceeds 1 per cent. These together comprise a total of 70 percent of the whole material. The most frequent species are as follows:

	per cent
Eristalis arbustorum L.	11.73
Spharophoria scripta L.	8.73
Syritta pipiens L.	5.69
Malenostoma mellinum L.	4.52
Episyrphus balteatus DEG.	4.21

In the course of collecting, there were found several interesting, rare species, and even some which are new in the fauna of our country.

(22) FARKAS, Á.:

The role played by the dead arms and borrowing pits in the natural prolification of fishes in the Tisza

It is a decisive factor in the natural prolification of fishes in the Tisza that the flood plain is from time to time inundated by the river. These are in the months March and May the spring-flood, in September and October, owing to the autumnal rainfall, the so-called leafy-flood. At spring and summer floods, the fishes getting to the flood plain can spawn on the branches of trees and bushes in the water getting fast warm, and the hatching young fish finds a safe living in the flood plain.

Together with the receding water, a part of them get back into the river, but another part are bogged in the dead arms and borrowing pits of flood plains. In case of a persistent drought, this means a sure perdition for the young fish.

Our national economy uses every effort for increasing our fish production. We augment the more and more increasing market demand on fish of our country with artificial multiplication and young fish supply, as well as with an intensive piscicultural fish-breeding.

I regard it as necessary, to increase the fish production of our national economy with the help of the organized protection of the young fish in the borrowing pits of the flood plain and the promotion of the natural progeny of the dead arms.

Contributions to the discussion:

SZITÓ, A.: The decrease of the fish stock in the Tisza is not caused by that the young fishes perish in the borrowing pits.

CZIZMAZIA, GY.: An uniform lake-system should be formed out of the borrowing pits where the growing up of the stock would be ensured. — Answer: This would demand an exagrated investment and the food supply would not be ensured even in this case.

MARIÁN, M.: Our fish stock and its output should be increased by protecting the multiplication of fish in this country. — Answer: Fishers are not additinally remunerated for protecting young fish.

HORVÁTH, I.: Can we solve the increase in fish output with domestic fish species? — Answer: There is little demand for the meat of the so-called herbivore fish introduced from the Far East but, at the same time, these increase the output of fish-hatcheries considerably.

VÉGVÁRY, P.: If owing to the decreased water level in the Kisköre Reservoir fishes remain outside, what a danger does this mean just in the time of spawning of the fish? — Answer: In case of recession, the majority of fishes get back, only a small part of them remain outside, in the flood plain.

LEGÁNY, A.: The borrowing pits in the Upper-Tisza Region are already liquidated, filled up. This process is going on in the Lower Tisza Reaches, as well.

(23) LEGÁNY, A.:

Part of the nesting bird colonies in the biotopes of the flood plains in the Upper-Tisza Region

The continually renewed and continuous ecological research work is made necessary by the natural environment changing as a result of human activity. The field of my work — the Tisza flood plain — lying from Tokaj up to Záhony — is also the scene of changes like this. I have regarded as my task, to investigate into the ecological role of nesting bird colonies to be found in this area. As a result of a four years long systemic work of observation and fact-finding, I have investigated into the bird colonies of various biotopes in the flood plain, establishing the quantitative and qualitative parameters of these and endeavouring to draw a conclusion in respect of their part in the biotope.

In the course of these investigations, I have established the following:

(1) The borrowing pits and mixed forests have the richest bird colonies. The value of biomass is here the highest. The minimum was found in the orchards and Canadian poplar plantations.

(2) In respect of the bird live-weight produced by 1 ha, as well, the mixed and borrow-pit forests take the lead. Minimum was found in the orchards. The grasslands, Canadian poplar plantations, and orchards support several bird colonies which only take nourishment there.

(3) The flood plain is mainly favourable for the arboricolous and dendricolous species, although only 10 per cent of the area is a forest.

(4) It can be established on the basis of the consumed food that in the area the

insectivores dominate, followed by herbivores, and — far after these — the mixed eaters and carnivores. Concerning the quantity of food, as well, I came to the conclusion that the sequence is identical with that above, only the dominance of insectivores is still more expressed.

(5) The flood plain is, in spite of its ecological complexity, an independent ecological and zoological unit.

(6) In the Canadian poplar plantations which are poor in species and individuals, the protection of forests can be increased successfully by introducing birds with artificial nesting-boxes. This was also verified by experiments.

Concerning the human activity to be carried out in this area, I have the following suggestions:

(a) At planting new forests, it would be advisable to bring about mixed forests, in harmony with the possibilities of the area.

(b) At logging, it would be necessary to leave untouched some smaller tree-groups and protected forest-parts which would be to a certain extent refuges for the bird kingdom of the flood-plain forests and the basic point of the departure of succession.

(c) In the domain of the field-growing of plants carried out in the flood plain, there are necessary some structural changes, meaning to grow more straws of hay and fewer hoed plants.

Contribution to the discussion:

MARIÁN, M.: He calls the attention of the lecturer to that he should follow with attention the change that began with filling up the Kisköre reservoir with water. He asks what this understood under the expression: functioning bird biomass. And whether the borrowing-pit forest is identical with the mixed forest. — Answer: He undertakes the outlined work. He admits that the "functioning biomass" is a bad Hungarian expression but it designates the number of birds that move, take nourishment in the given area. The borrowing-pit forest is identical with the mixed forest but having a special ecological situation and being more humido, and its stock is different, as well. These mixed forests take place in the highest section of the flood plain and are mostly artificially planted forests, without any underwood.

TRÁZER, GY.: He asks whether the lecturer divided into groups the biotopes and plants, and how the animals move between the single biotopes. — Answer: In any section of the investigated flood plain a survey of data was performed. There is a difference between the single biotopes (plough-land, orchard, acacia grove, river wall) and some motion between the biotopes. However similar the bird fauna of the forests is, on the basis of the single character-species, the single forest types they can be distinguished from one another well.

(24) CSIZMAZIA, GY.:

A contribution to the behaviour of *Talpa europaea,* living in the flood plain, during the flood

I obtained my data, connected with the theme — on the basis of explorations and borings — in the Region Conservation District at Mártély, in the years 1969, 1970, and 1977.

It is unambiguously proved by many hundreds of borings and measurings carried out by the professor's assistant ISTVÁN KONTUR under the leading of ISTVÁN ZSUFFA (1970. ATIVIZIG library, — Tisza-valley sections I, II), as well as by my own excavations in the flood plain after the flood waves had passed (1970, 1977) and by the model sections of borings that the life of mammals on the occasions of the Tisza flood waves, in the water-covered soil, is impossible. In the course of exploring 25 cubic metre earth in sections of research, we did not find any Talpid duct in which the animal could survive even at a flood of onty one week or two.

This aerobic species has a high metabolic value. At a flood, it does not penetrate deeper into the ground but, on the contrary, it strives to reach the dam, the protected area by a rapid escape and often by swimming between the enclosed islands. Gaskó's observations agree with my own data, according to which the humus level of the holms of high relief, enclosed with water, swarms with Talpids (e. g., in June, 1969, at Körtvélyes, on a holm of 6 sq. m, I collected 14 individuals).

After the flood wave had passed, the fresh mole-casts appearing on the surface, drying up with rents, originate from these animals. (Proved with the method of recapturing with marking).

The individuals escaping to the dam return at a very rapid pace. It could be ascertained that the Talpid stock was increasing in the flood plain of the Tisza and on the dam side.

I call the attention to the indicator role of the Talpa. Its biotope is contracting more and more owing to the environmental pollution, the intensive chemical processing. And the dynamical development of the local Tisza populations may have been a consequence of those mentioned above. The mole-casts are indicating the "living" ground that is free from any chemical poison. We should deal in an increased degree with the activity of Talpa on the occasion of the Tisza flood waves because the groundwater-level values, known until now, are changed by our present-day reservoirs and those in process of construction.

An establishment, according to which the mole, escaping from floods, digs its ducts deeper into the ground, is sopposedly caused by an erroneous conclusion. By reason of the results of my investigations I cannot support this. For deciding this question, the local revealing excavations and recapturing methods cannot be omitted.

Contributions to the discussion:

VÉGVÁRY, P.: Do the moles escape from the flood plain one day or two before the flood coming? — Answer: At moles this cannot be observed. As they like dampness, they only escape if they are inundated by water. In case of flood, they assemble on the waterfree holms of the flood plain.

GALLÉ, L., Jr.: Is the method of "recapturing with marking" to be considered as suitable for estimating the population? Has the lecturer studied the ecological role of moles? There were namely, for lack of competition, a great many animals immigrating into the flood-plain areas, which became emptied after the flood, in the R-seceltive phase of re-stocking. — Answer: He has not investigated the latter problem in details, his main aim being to take the stock.

MIKES, M.: The mole-ringing is also probably to be solved and so this method may be suitable to establish the density of stock.

BODROGKÖZY, GY.: The biotope of mole becomes really more constricted. According to his observation, in case of using chemical fertilizers, it escapes even from the week-end smallgardens. — Answer: The materials containing ammonia have an alarm-effect on moles.

MARIÁN, M.: What is the lecturer's establishment that the mole is not attacked by the little owl, based on? — Lendvay's answer: In the course of investigating casts, there could not be found any bodily remain of a mole. In those of tawny owls, however, there could.

(25) ERDEI, M.:

Nutrition-biological investigation of fox-populations living in the flood plain of Tisza—Maros

The fox is our most frequent mammalian species. It is the only one of the fur-bearing predatory animals in this country which was able to adapt itself completely to the changed environmental-natural circumstances.

The aim of the investigation was to get data on what the part of the fox is in the order of biocoenosis, in the flood plain of the Tisza—Maros, i. e. in the biotope that is the most comparable to the ancient natural conditions. What is its economic damage, resp. benefit realized in? How do the inundations exert their effect on the density of population, habit of life, and movement?

From the data, obtained between 1974 and 1977, by analysing and determining the gastric content of 71 foxes, as well as 185 prey-remainders and excerta found on the ground, we can draw the following conclusions:

The fox is an active and useful maker of the order of biocoenosis in the flood plain. It is replacing the activity of the winged and fur-bearing predatory animals that were exterminated resp. depopulated in the meantime, as much as it is possible at all under the changed conditions. The economic damage is expressly of game-economic direction. It causes damage first of all by plundering pheasants. It is to be put to its credit that it destroys small rodents. In the flood plain, however, this is a negligible activity, taking into consideration that there is hardly any agricultural work there any more.

The populations are not hit too hard by inundations. They retire from flood to the protected side. The range of their motion is correspondingly modified. On occasions like this, the density of foxes is greater in the areas bordered by the flood plain. After the retirement of water, foxes return to the covered flood plain which offers a good covert lair.

Contributions to the discussion:

LEGÁNY, A.: How did the lecturer establish that the fox had eaten a carcass? The fox is useful not only in the flood plain nut in other areas, too. In its burrow, it can always be found a considerable amount of the remainders of hamster carcasses. — Answer: The colour of meat of carcass-origin always differs from thet originating from living animals. Under microscope, even maggots are to be seen in it.

MIKES, M.: The fox is the carrier of rabies. In the vovivodeship (Voivodina), it is therefore destroyed. According to his observations, its nourishment consists mainly of mouse-like mammals and only rarely of pheasant or partridge. In the agro-biocoenosis it is, therefore, a helpmate of man.

GALLÉ, L., Jr.: The fox is an important top-level predatory animal, it has, therefore, even in the domain of sorting out the small game, an important part which would be unsolvable in another way. He asks if the lecturer found in the diversity prey-animals any difference between the flood-plain forests and the agricultural areas. He asks, further on, why the fox-stock should be regulated artificially if the predatory population is also regulated by automatic density-dependent factors. — Answer: In the flood plain, the food of fox is more composed. It has no self-regulating mechanism. It is destroyed from time to time by scabies and rabies but not in large numbers.

GASKÓ, B.: The question of rabies must not be minimized. The human number catching this disease can be expressed in an order of magnitude by thousands. It would be right to stop up the fox-holes and asphyxiate foxes.—Answer: It would be the right solution, if the fox population could be held back at low level. Poisoning of them, however, cannot be suggested.

MARIÁN, M.: Concerning Amphibia, there is a very good comparative skeletal material in the Museum of Szeged. The lecturer could use this material very well to his further research work.

(26) KISS KEVE, T.:

Effect of purified waste-water on phytoplankton associations

The waste-water, flowing from the industrial live-mud sewage filtering farm of the integrated Tisza Chemical Works, loaded with communal sewage, as well, gets into an after-purifying lake system. As a function of the live-mud system and the processes taking place in the lakes, there are formed different algal associations in the lake system. From among these, we are presenting here some characteristic ones: (1) 12. IX. 1975:

The purified waste-water getting to the lakes is poor in organic matter (KOI_{Cr} 35.7 mg/l), rich in phosphorus, nitrogen (Po_4—P 1.1 mg/l). 20—80 per cent of the bottom and watermass of lakes is densely overgrown with *Cladophora*. A small algal association of low individual and species number develops, poor in water (0.22—0.37 mill. ind/l).

(2) 2. II. 1976:

The organic-matter content of the purified waste-water is: KOI_{Cr} 51.1 mg/l. It is well-supplied with phosphorus, nitrogen (Po_4—P 0.26 mg/l). The lakes are covered with brittle ice, the *Cladophora* stock shows decreased vital functions in the cold water. In the water, a plankton-algal association of low species-number and rich in individual number develops, in which *Chryptomonas*, *Cyclotella*, *Chlamydomonas* species (1.3—16 million ind/1) predominate.

(3) 2. VII. 1986:

The organic-matter content of the purified waste-water is high (KOI_{Cr} 74.1 mg/l), it is rich in phosphorus and nitrogen (PO_4—P 1.34 mg/l). Owing to that the internal purifying system was overladen, the lakes got but badly purified waste-water previously. The *Cladophora* stock was destroyed by fungal infection, the degree of autosaprobity rose. Bacteria and fungi proliferated in individual number per a thousand million litres. In this state of high pullulation, although the food supply was abundant, there appeared only a poorish algal association in the water (0.79—1.7 million ind/l).

The organic-matter content of the purified waste-water is high (KOI_{Cr} 108 mg/l), its phosphorus, nitrogen supply is low (PO_4 – P 0.09, total P 0.364 mg/l). In the lakes, a rich, mixed reed-grass stock developed, binding a large part of phosphorus and nitrogen. Apart from the rich reed-grass stock, in contradistinction to those, experienced in 1975, the phytoplankton was also rich in species and individuals (33.6—66 million ind/l).

Contributions to the discussion:

VÉGVÁRY, P.: He asks if the high orthophosphatic value is showing the value of the inflowing or leaving water. — Answer: The orthophosphate was higher in the leaving water. It is regrettable that the lake was planned badly. There would be necessary a bulruch or reedy strip to the fore-part of the algal lakes. Then it could filter out the mud overflowing from the sedimentator. It would be advisable to form out some reed-grass vegetation of large mass and remove it from time to time. With continuous mowing the *Cladophora* stocks could be induced, to produce continually and continuously.

KISS, I.: In how deep water did *Chlamidomonas* grow? — Answer: In a water of 1.5 m depth. The algal production is the result of several external and internal factors. Stimulating matters have a considerable part. The rhythm of the development of algae is a similarly important factor.

B. TÓTH, MÁRIA: Did the high nutritive-matter content incorporate into the macrovegetation? — Answer: It incorporated only partly.

The two days long Conference has terminated with presidential concluding words.

The compiler's special thanks are due to Dr. M. MARIÁN, P. VÉGVÁRY, and Dr. GY. GYŐRFFY for making available to him their lecture notes, rendering him help in this way at compiling the material of the Conference.

Presidential suggestions
at
Tisza-Research Conference IX

(1) Parallel with filling up the Kisköre Reservoir, the quantitative and qualitative changes in water quality, living world, and in the mesoclimate of the adjacent areas should be followed with increased attention.
(2) The botanical and zoological investigations should be increased in the area of the area of the Tisza III river barrage, the basin at Alpár, fixing the present-day states and indicating the most valuable areas for a possible protection.
(3) It is desirable that in the emphasized Tisza-stretch but primarily in the Region Conservation District at Mártély-Sasér, the botanical and zoological investigations take place jointly.
(4) It is desirable that the ecological and ethological investigations become deeper in any field of the investigation.
(5) The investigations in the Upper-Tisza district should be made more systematical. It is desirable to select a dead arm in the area of the Nature Conservation District at Szatmárbereg, which is characteristic of the Upper Tisza fora possible region reconstruction.
(6) The Tisza-Research Working Committee renders help to the stock-taking of animal and plant species living in the area of the Nature Conservation District at Szatmárbereg and draws up a proposal for the list of the plant and animal species calling for a priority in being protected.
(7) We should strive, to carry out in 1978 the surveys of informative character in the Soviet and Jugoslav Tisza-stretches, in the framework of the co-operation, going on with the Sovietunion and Jugoslavia. As a result of this, the investigation areas getting priority can be marked out in both Tisza-stretches, and the aims of the later scientific research work can be composed.
(8) It is justified that the Tisza-Research Working Committee holds Conferences two times annually, one of these in April, the other in November. The Conference in April should last two days, that in November one day.
(9) Owing to the deterioration of the water quality and the bacteriological characteristics of the Tisza and its tributaries, it is desirable to call the attention of the compoetent organs to the problems emerging in the course of the utilization (e. g., irrigating water). For elaborating the concrete proposals, a round-table Conference should be organized in September, 1978.
(10) It should be initiated by the Tisza-Research Working Committee, towards the, Hungarian Academy of Sciences, to begin publishing a Tisza-monograph, consisting of volumes, to be made continously. The first volume, dealing with physical (natural) geographical and climatological questions, could be prepared until April, 1979. The second volume would summarize the rexults of water-body investigations, performed so far.
(11) It is desirable to extend the botanical investigations with the co-operation of new co-workers and to enlarge these to the plants of lower organization.
(12) The co-operation with the organs of the water administration and the National Office of Environment and Nature Conservation should go on being increased, in order ot promote the reaization of the planned reconstructions.
(13) It is desirable that the work of the original members who have been active with good results in the Tisza-research, should be acknowledged by the Hungarian Academy of Sciences in an adequate form.

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